
VIA VERITAS VITA
THEO CINA
LOGIA ARTES
JUS LIBER
MEDI ALES
AB ANIMO
CALIGINEM
DISPELLERE

Fig: 1. Endogenous Stem *Fig: 2. Exogenous Stem*
Fig: 3. — Leaf *Fig: 4. — Leaf*
Fig: 5. Ovary superior (Stamens inferior or hypogynous)
Fig: 6. Ovary inferior (Stamens superior or epigynous)

OUTLINES

OF

MEDICAL BOTANY,

COMPRISING

VEGETABLE ANATOMY AND PHYSIOLOGY,

THE CHARACTERS AND PROPERTIES OF THE NATURAL ORDERS OF PLANTS,

AN EXPLANATION OF THE

LINNÆAN SYSTEM OF CLASSIFICATION,

AND

TABLES OF MEDICINAL PLANTS, ARRANGED IN THEIR LINNÆAN AND NATURAL ORDERS.

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ADVERTISEMENT.

An elementary work on Botany, adapted for the use of Students of Medicine, has been much wanted. In compiling the present work to meet this desideratum, I have endeavoured to make such a selection from the immense mass of facts which Botany now includes, as shall present a concise but satisfactory view of our present knowledge of the science, and form a proper introduction to the study of individual plants.

Before commencing the study of individual plants, it is necessary to acquire a knowledge of the structure and functions of the different parts of plants, and of the principles of some method of classification. This work, accordingly, consists of two parts. In the first, there is given as minute an account of the structure and functions of

the various organs of vegetables, as is consistent with the plan of the work, while care has been taken to avoid too much detail on matters which, in the present state of our knowledge, do not lead to any useful application. The second part consists of Systematic Botany; and includes a full explanation of the Natural Method of Jussieu, the characters of the most important of the Natural Families which he has pointed out, an account of the various uses to which the plants in each family may be applied, and an explanation of the Linnæan System of Classification. Full tabular views of the methods of Linnæus and Jussieu are added, and also tables shewing the medicinal plants arranged in their Linnæan and Natural Orders, so that the situation of any plant in either of these arrangements may be easily found. If the student be well acquainted with these two methods, and know the Natural and Linnæan Orders in which a plant is placed, he will have already acquired much important information regarding it.

A knowledge of the simple and beautiful system

of Linnæus is almost indispensable for acquiring a knowledge of plants; but to study Botany as a science,—to view plants as component parts of one great system,—to examine their mutual relations and affinities, the connexion between their internal structure and external characters, and between these and their properties, we must have recourse to the comprehensive and philosophical system of Jussieu.

Till within these few years, almost all the elementary works on Botany in this country were devoted chiefly to an exposition of the Linnæan method of arranging plants, and hence were very imperfect in a medical point of view, as it is only by means of the Natural Method that Botany, as a science, can be applied to Medicine. Now, however, the importance of natural classification is beginning to be more highly estimated, and a knowledge of it is deemed essential to every student of Botany: the examination of the natural affinities of plants is the principal study of the most eminent botanists, both at home and abroad; and the

development of this system forms a prominent part in the best elementary works. It is hoped, therefore, that a work which comprises in a small compass the Anatomy and Physiology of Vegetables, the Principles of Natural Arrangement with the Characters and Medicinal History of the Natural Orders, and an exposition of the Linnæan System, may prove useful to the Student of Medicine.

EDINBURGH,
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PART II.

OUTLINES

OF

MEDICAL BOTANY.

INTRODUCTION.

1. The object of Botany is to describe the Structure, Functions, Characters, and Uses of Plants. It is not, as some have imagined, a mere catalogue of names, or description of external characters; it is a science, embracing an extensive series of phenomena of a complex and interesting nature, and the investigation of the laws by which they are regulated. It consists of,

I. Vegetable Anatomy, or an account of the structure and appearance of the different parts of vegetables;

II. Vegetable Physiology, the object of which is to investigate the various functions performed by vegetables;

III. Systematic Botany, or *Botany* according to the usual meaning of the term, which treats of the principles on which plants are grouped together in divisions and subdivisions, that we may more easily acquire a knowledge of them, and describes the characters of the Classes, Orders, &c. in which they may be arranged.

2. Taken in the widest sense of the term, Botany also includes a knowledge of those properties of plants which render them interesting to man,—their nutritious, medicinal, or poisonous qualities. Indeed, the most important object of Systematic Botany is to make us acquainted with the relations which exist between the various properties of plants and their appearance or structure, that we may be enabled from the latter indications, to judge how far particular plants may be rendered serviceable, or how far they are of a noxious nature and must be avoided. This is Medical Botany, and forms the principal part of the present work. Introductory to this, however, a knowledge of the structure and functions of plants must be attained: it is the ground-work of the whole.

3. It is almost needless to give a definition of vegetables, but it is necessary to take a view of their station among the productions of Nature.

4. The objects which compose the material world have been arranged in two grand divisions, according as they possess or are destitute of Life—the *Animate* and the *Inanimate* creation, or *Organic* and *Inorganic* bodies.

5. The former, Animate or Organic bodies, are characterized, 1st, By possessing an organic structure, that

is, in being composed of a variety of parts or organs, differing from each other in form and texture, and adapted to different uses; 2dly, By their power of introducing into their most internal parts new matter, differing from their own substance; separating what is of use from what is useless or noxious, and rejecting the latter; and assimilating the former, that is, forming it into organs similar to their own, and rendering it a part of themselves, increasing in size by *intus-susception:* 3dly, By their power of resisting or suspending the chemical action of external agents and of their own elements upon each other. These three properties united form what is called *life.* A fourth characteristic of animate bodies is the power of reproduction, of forming a being in every respect similar to themselves. 5thly, We may observe their decay or death at some definite period, always the same in the same kind, not from the action of external forces, but from the inability of their organs to carry on their functions longer. And, lastly, it is not unworthy of notice, that their external surface is smooth and rounded, seldom or never formed into a regular plane or angle.

6. Inanimate or Inorganic bodies constitute what is commonly called the Mineral Kingdom. They are of a homogeneous structure, their particles being similar in form, arrangement, and chemical composition; increase in size only by addition to their external surface —by *juxtaposition;* externally are rough and angular; have no power of resisting the influence of chemical affinities; have no power of reproduction; and have no definite period of death or decay, being capable of existing unchanged for an unlimited period when not sub-

jected to chemical or mechanical action from external sources.

7. Such are the leading distinctions between animate and inanimate bodies. The former are subdivided into Animals and Vegetables. It is almost impossible to give diagnostic marks between these two classes which shall include all the genera, because some of the tribes in each very much resemble each other; but, in most cases, animals are known by possessing sensation and voluntary motion, while vegetables appear to be endowed only with irritability and a simple kind of motion, which depends on the influence or application of some external stimulus; and it is by its irritability that the part of the plant is enabled to contract and move upon the application of this stimulus.

8. As a general distinction, the concise definition by Linnæus is admirable, "Minerals grow *; vegetables grow and live; animals grow, live, and have feeling." These distinctions, so well marked in the higher orders of each, disappear in the lower grades, where the animal and vegetable kingdoms approximate; and it is often impossible to distinguish them from each other. Many of the Polypi are destitute of voluntary motion, and would appear to be almost void of sensation; while some of the Algæ, as the Oscillatoriæ and the Conjugatæ, and several species of Diatoma and Fragillaria, possess irritability and mobility in a high degree, and have much of the character of animals—that is, the very simplest species of animals, such as the Infusoria. The *Polypi vaginanti* were placed among vegetables in

* By the growth of minerals is meant their increase in size by the external deposition of additional portions of matter.

Tournefort's arrangement: more lately, some species, formerly supposed to be Confervæ, have been removed from vegetables and placed among the simplest tribes of the animal kingdom by M. Bory de St Vincent. The Naviculariæ appear to be produced occasionally from minute vegetable sporules, and it is supposed that there are particular forms of organic matter which give rise equally to animals and vegetables. Some cryptogamic botanists hold the singular doctrine, that in certain cases metamorphoses of plants into animals, and of these animals into plants again, take place; and Agardh is of opinion, that the mineral kingdom approaches the other two in some of the simpler Algæ, which have a crystalline texture. This difficulty of diagnosis, however, occurs only in the more minute and simple tribes of the animal and vegetable creation.

9. A remarkable property of vegetables, though not a means of diagnosis between them and animals, is their great tenacity of life;—the length of time during which they can preserve the vital principle, as exemplified in seeds, bulbs, and grafts;—the readiness and ease with which they throw out new parts, and repair what appear to be very serious injuries;—and the facility with which they can adapt themselves to the most unfavourable circumstances. The operations of grafting, and of propagation by slips and layers, the sprouting of young shoots from trunks which have lost their connexion with the soil, and many other well known examples, might be adduced. A plant would seem to be a collection of vital germs united together, but not necessarily connected, each being capable of a separate existence when placed in a favourable situa-

tion. This appears less surprising, however, when we consider the extreme simplicity and the uniformity of the internal structure of vegetables—the small number of organs by which their functions are carried on—and that those essential to their existence are in a manner spread over or common to the whole plant, as the bark; not being confined to a particular part, like the heart, lungs, brain, or intestinal canal, in animals. The bark, perhaps the most important part in the economy of the plant, is not, like the circulating system in animals, divisible into two distinct parts—heart and bloodvessels; it is one uniform structure in every part. The simplicity and minuteness of the organs which carry on the functions of plants have prevented us obtaining an accurate idea of those functions. All the parts bear, in their minute structure, such a resemblance to each other, that we cannot detect those structural differences which are the first clew to the discovery of differences in function. Hence our knowledge of the physiology of vegetables is very imperfect.

10. How far plants are endowed with vitality is a question that has excited much discussion. Some have advanced the opinion that they possess a low degree of sensation; that they possess irritability is evident, and an eminent physiologist has gone so far as to point out the seat of a nervous system, which he considers somewhat analogous to that found in animals. M. Dutrochet found that a greenish matter which exists in the cells of plants is affected by chemical reagents in the same way as the nervous substance in animals, and he supposes that these greenish globules constitute a nervous system diffused over the whole plant. A che-

mical analogy such as this, however, can prove little except supported by other phenomena, leading to the same result.

11. The only phenomena in the physiology of plants which have any appearance of being connected with a nervous system are those which are more correctly said to be caused by their irritability. Examples of this property in plants are within every one's observation. The turning of leaves and flowers to the light, even though repeatedly put out of their natural position, and the opening and closing of flowers, are well known. The stamens of the Rock-rose (*Helianthemum*) and of the Barberry (*Berberis*) possess the peculiar property of bending when irritated by any sharp body. The leaves of the *Hedysarum gyrans*, a plant found in India, are almost constantly in a state of motion. The leaf of the *Dionea muscipula* (Venus' Fly-trap) is provided with bristles, and, when irritated by an insect, it becomes folded and crushes the animal. The most remarkable instance of irritability in vegetables is afforded by the sensitive plant (*Mimosa pudica*); when touched or agitated by the wind, the leaflets become erect, and closely applied to each other and to the stalk, but they gradually resume their original position when the stimulus is withdrawn. Besides these, there are many other instances which it would be unnecessary to enumerate here: indeed it is not improbable that it is by a kind of irritability, or contractile power, that the rootlets are enabled to absorb the juices, and the vessels to propel their contents. It has also been lately ascertained that vegetables are acted on by those poisons which are supposed to affect animals through the

medium of the nervous system, as hydrocyanic acid. The effect generally was to produce a kind of contractile action, and diminish the sensibility of the plant to the usual stimuli.

12. These facts, however, are far from proving that vegetables, in any case, possess a nervous system. They resemble actions which we see in animals possessing a nervous system; at the same time we see such actions in animals which appear to be quite destitute of a nervous system, as the Polypi; they do not necessarily shew that plants have such an organ. We see that they are capable of receiving impressions from external sources, and producing some action thereupon, but we have not any evidence of an intermediate organ which receives the impression and transmits its influence to the acting body: it is perfectly possible that the external stimulus may act directly upon the part that moves. The phenomena mentioned above are easily accounted for on the principle of irritability, which seems to pervade almost every organic being, from the Mammalia down to the simplest Moss or Conferva.

13. Plants, then, occupy a station intermediate between the animal creation and inorganic bodies; differing from the latter in possessing *life* (see 5.), and from the former in being destitute of the higher and more complex vital functions with which they are endowed.

PART I.

VEGETABLE ANATOMY AND PHYSIOLOGY.

SECTION I.

GENERAL ANATOMY OF VEGETABLES.

14. Vegetables are composed of solids and fluids: the former give firmness and stability to the vegetable frame; according to their mode of arrangement, determine the peculiar form of the plant; contain and circulate the vegetable juices; and deposit them in their proper places:—the latter support the growth of the vegetable, by supplying it with nutritious matter. This matter is modified and deposited in appropriate situations by the previously existing solids excited to action by peculiar stimuli, and regulated by the vital principle; and thus forms successively the various solid parts and fluid secretions which constitute the vegetable.

15. The solid part of vegetables, when minutely examined, is found to consist of fine membrane, forming, by the different modes in which it is folded, two elementary tissues, called Cellular Tissue and Vascular Tissue.

CHAP. I.—CELLULAR TISSUE.

16. The cellular tissue consists of minute cells, utricles, or vesicles, with thin and transparent sides. The form of the cells varies in different parts; where they are subjected to little pressure, they are globular, as in the leaf; when only exposed to the equal pressure of the adjacent cells, they become hexagonal, as in the medulla or pith; when strongly pressed by the vascular tissue, or woody parts, they are stretched, and assume an elongated, cylindrical, or tubular form, as in the bark and in the wood. The cellular tissue is the pulp or parenchyma of old authors.

17. Each cell is complete in itself, the wall or partition between two cells being double, or formed of two layers of membrane. Frequently the cells do not adhere to each other at every point, in which case what are called "*intercellular spaces*" exist between them. When a number of these spaces are placed one above another, they constitute the "*intercellular canals*," which, M. Keiser supposes, are the chief organs for conveying the sap.

18. The membrane of which the cellular tissue is formed, is destitute of visible pores: it must be pervious, however, as the cells frequently contain fluids which afterwards disappear from them. Small dots observed on the sides of the cells have been supposed to be apertures for the passage of fluids. Many physiologists consider the cellular tissue as the medium by which the sap is conveyed upwards.

19. The cellular tissue is found in all vegetables:

and many, as Sea-weeds (*Algæ*) and Mushrooms (*Fungi*), consist of it alone. In the higher orders of vegetables, as trees, it alone forms the pith; it exists compressed and elongated in the wood and in the bark, forming longitudinally cylindrical layers between each layer of vascular tissue, and also connecting the vessels to each other; it extends transversely from the pith to the bark, forming the medullary rays (104); and in the leaf fills up the spaces between the vessels. In many parts of plants the cells occasionally contain nothing but some kind of gas, but in general they are filled with fluids, as in fruits, the juices of which are contained in the cellular tissue.

CHAP. II.—VASCULAR TISSUE.

20. The vascular tissue consists of bundles of tubes or vessels, each tube being formed of one layer or more of elementary membrane, rolled up in such a manner as to form a cylindrical canal. Considered with respect to their appearance and structure, they may be divided into six kinds.

(1.) The *porous vessels*, continuous tubes, with a number of opaque dots or points in their sides, generally considered as pores; found in the woody layers.

(2.) The *false spirals*, or slit vessels, tubes with many transverse slits in their sides; found in the woody layers.

(3.) The *spirals*, which consist of narrow bands of elementary membrane rolled up spirally so as form tubes. If a ribbon be wound spirally, edge to edge,

round a stick, and the stick be pulled out, the ribbon will represent the structure of a spiral vessel. They are found chiefly in the medullary sheath (106), and in the leaf and flower, never in the bark, seldom in the root, and only in plants provided with sexual organs (205). They have been called *tracheæ*, from the opinion once entertained that they convey some kind of gas.

(4.) The *mixed vessels*, alternately porous, slit, and spiral; found in the woody layers.

(5.) The *beaded vessels*, or vessels *en chapelet*, porous tubes contracted at various distances, so as to present an appearance like that of a string of beads; found in those parts in which the perpendicular growth is obstructed, as in the knots of the trunk, at the junction of the root and stem, or of the stem and branches.

(6.) The *proper vessels*, simple tubes, without any pores or slits, the sides being perfectly entire; found in the bark.

21. Considered with regard to their functions, the vessels may be divided into two kinds: 1. The *sap-vessels*, which convey upwards to the buds and leaves the fluids absorbed in the earth. 2. The *proper vessels*, which convey downwards from the leaves the fluid which in them has been rendered fit for the nutrition of the plant.

22. The first five kinds of vessels mentioned in par. 20, are supposed to be sap-vessels, and are found chiefly in the alburnum (101), and in the medullary sheath (106). The sixth kind are the proper vessels, and are found only in the bark.

23. The vessels originate as *absorbents* in the root, in which they draw the nutritive fluids from the soil;

and they terminate in cellular tissue, in other vessels, and in exhalants by which fluids are discharged. They have the power of exercising an inverted action, that is, of absorbing or exhaling nearly equally well from either extremity. Young trees may be made to grow in an inverted position, the branches taking root when placed in the earth, and leaves and flowers coming forth from the roots (122).

24. In herbs, the fasciculi of vessels are often placed at great distances from each other, presenting the appearance of small columns dispersed through the cellular tissue. In many plants, the vessels are more thickly set, and are scattered irregularly through the cellular tissue; see Frontispiece, Fig. 1. In most trees, they are disposed regularly round a central column of pith, exhibiting, in a transverse section, the appearance, so familiar to every one, of concentric circles; see Frontispiece, Fig. 2. They are found in every part of the plant except the pith. The vessels contain and circulate the fluids necessary for the growth of the plant, and deposit each in its proper situation.

25. Vessels are found in the generality of plants, but some of the lower orders, as Algæ, Lichens, &c. are destitute of them. Plants are divided by some botanists into two great classes, according as they possess or are destitute of *spiral vessels* (20);—the *Vasculares,* which are furnished with spirals, corresponding with the Cotyledoneæ of Jussieu, and including all the higher orders; and the *Cellulares,* which do not possess spirals, corresponding with the Acotyledoneæ of Jussieu, and including the lower orders, as Ferns (*Filices*), Mosses (*Musci*), &c. See 424–5.

26. Notwithstanding the infinite variety in form and texture observed in the objects which compose the vegetable world, they all consist of these two tissues, which, by their union in various ways, form those organs (common to almost every vegetable, and familiar to every one as distinct parts of the plant) which are called Root, Stem, Leaves, Flowers, and Fruit. They may be called compound organs, because they are capable of being resolved into these two primary tissues or organs.

27. These compound organs arise from the growth either of a seed or bud, each of which, when exposed in a fit situation to the action of certain stimuli, being endowed with a vital principle, is capable of enlarging —downwards in the form of Root or Wood, and upwards in the form of Stem and Branches, Leaves, &c. The growth of a germinating body (bud, or seed) in these opposite directions constitutes *vegetation.*

28. The point between the root and stem, is the *neck* or *life-knot, collet* of the French. If this part be seriously injured in a young plant, it will not live; though the stem or root may be cut away without much danger, as in young plants these parts are easily renewed. The root, or part which grows downwards from the neck, is called the *descending axis,* while the stem, which grows upwards from the same point, is called the *ascending axis.*

29. The compound organs may be divided into two great classes: the *Conservative Organs*, and the *Reproductive Organs.* The former, consisting of the root, stem and branches, and leaves, serve for the support and growth of the vegetable: the latter, consisting of

the several parts of the flower, and fruit, form the seed, or rudiment of a new plant similar to that which produced it.

SECTION II.

ANATOMY AND PHYSIOLOGY OF THE CONSERVATIVE ORGANS.

30. These have for their object the preservation of life in the vegetable. The Root draws nutritive fluids from the earth; the Stem transmits them to the leaves; and the Leaves render them fit for the nutrition of the plant.

CHAP. I.—THE ROOT (*RADIX*).

31. This is the lower extremity of the plant; fixes it to the soil or to the substance on which it grows; and absorbs nutritious matter for its support.

32. As commonly spoken of, consisting of all that part which is under the surface of the soil, it may be divided into three parts: the caudex, body, or middle part, sometimes much enlarged, as in the Turnip and Carrot; the collar, collet, crown, or life-knot, the place where the root and stem are joined, which may be considered either the lower part of the stem or upper part of the root, and from which, in perennial roots (37), the bud of the annual stem springs; and the radicles, rootlets, or small fibres, in which the root terminates inferiorly.

33. The radicles are always present, and are essential, as it is these alone that imbibe nutritious matter from the soil. This absorbing power resides in the extremity of each radicle, at which part there is an expansion of the cellular tissue, called a spongiole, provided with numerous pores, through which the fluids pass.

34. Roots are divided, according to their duration, into *Annual*, *Biennial*, and *Perennial* roots.

35. ANNUAL roots produce the herbage, flowers, and fruit in one season, and then entirely perish. Barley (*Hordeum*) and the Red Poppy (*Papàver Rhœas*) are examples.

36. BIENNIAL roots produce herbage in the first summer, live through the ensuing winter, bring forth flowers and fruit next summer, and then entirely die Carrot (*Daucus carota*), Foxglove (*Digitalis*).

37. PERENNIAL roots are those of plants which bear leaves and flowers during many successive years, as trees, and many herbaceous plants: but the term is more generally applied to those roots which annually send forth herbaceous stems, which flourish and die in one season; Asparagus. The annual stem dies down to the neck or life-knot, from which, in the ensuing season, another rises.

38. The small fibres, which terminate the plant inferiorly, are supposed, in every case, to be annual, being destroyed by the cold of winter, and renewed in spring to perform their important functions.

39. Some annual roots, it has been said, vegetate for two years or more, when transferred to a warmer climate and a richer soil: and perennial plants frequent-

ly become annual when transferred from a warm to a cold climate. The Castor-oil plant (*Ricinus communis* or *Palma Christi*), the Mignonette (*Reseda odorata*), and the Indian Cress (*Tropæolum majus*), are perennial, or even woody trees or shrubs in their native countries, but annual in our cold climate.

40. According to their form and structure, roots have been divided into seven kinds, the Fibrous, the Creeping, the Fusiform, the Abrupt, the Tuberous, the Bulbous, and the Granulated. When these kinds of roots are spoken of, it must be borne in mind, that, by the term Root, is meant " all that part of a plant which is under the surface of the earth," the situation and form of the part being referred to, and not its structure or function. By the term " true root," is meant the fibres which absorb the fluids from the soil. The true root never becomes green when exposed to the action of air and light.

41. Fibrous Root. This is the most simple of all roots, being composed merely of a great number of small fibres, as in most of the Grasses, Wheat, Oats, Barley, and many other annual herbs. This kind of root is found chiefly in monocotyledonous plants (406).

42. Creeping Root (*repens*). This may be considered a kind of subterraneous stem, creeping horizontally under the surface of the ground, and putting out as it goes along numerous fibres, which constitute the true root; Couch Grass (*Triticum repens*), Mint (*Mentha*).

43. Fusiform Root, or Tap Root. The Radish, Parsnip, and Carrot, are examples of this kind. The spindle-shaped or tapering part is the caudex or body;

and this may be compared to the stem, as it contains the sap and proper juices of the vegetable, the red part of the carrot being analogous to the bark of true stems, while the real roots are the small fibres or radicles which it throws out on all sides, as they alone draw nourishment from the soil.

44. Vertical roots, such as these, are found only in dicotyledonous plants (408).

45. Abrupt Root (*præmorsa*) appears as if it had inclined to descend perpendicularly, like the Radish or Carrot, but had met some interruption which caused it to terminate abruptly; Devil's Bit Scabious (*Scabiosa succisa*).

46. Tuberous Root. This term is applied to roots, or rather subterraneous branches, which have at different points fleshy swellings, enlargements, or tubercles. These are not true roots—they do not draw nutritious matter from the earth. They are stores of nutritious vegetable matter, intended to nourish the herb of the ensuing season, and accordingly are found only in perennial plants (37.): Potato (*Solanum tuberosum*), Orchis, Common Dropwort (*Spirea filipendula*), are examples.

47. These tubercles may be considered thick, short, fleshy, subterraneous stems; the eyes on their surface being analogous to the buds on the stem. The Potato is propagated by means of these fleshy tubercles; and only those parts of the mass which have eyes (concealed buds) have the power of producing new plants.

48. In the Orchis, which has two tubercles, and the stem of which dies annually, one of the tubercles affords nourishment to the annual stem, shrinks, and dis-

appears. The other contains nutrient matter for the growth of the stem of the succeeding season, and disappears in its turn; and gradually a third is formed to serve the same office in the ensuing season: and so on for many successive years.

49. When there are two tubercles, the root is called *twin* or *didymate*; Military Orchis. When the tuber is divided deeply by fissures extending to the middle of its substance, presenting an appearance like the hand and fingers, it is called *palmate*: Spotted palmate Orchis (*Orchis maculata*). When the tuber is divided still more deeply, it is called *digitate*: White Orchis (*Satyrium albidum, Habenaria albida* of Dr Hooker.)

50. Bulbous Root. This root is of three kinds; *tunicate* or coated, consisting of concentric hollow spheres, as in Onion (*Allium*), Squill (*Scilla*); *solid*, in which the tunics may be supposed to be closely pressed together, as in Crocus, Buttercup (*Ranunculus bulbosus*), and in Meadow Saffron (*Colchicum*); and *scaly*, with scales covering each other like the slates on a house-top, as in the Lily (*Lilium*).

51. This root consists of a flat plate or disc, sending off from its under surface a bundle of fibres, or fibrous root (which is the true root), and supporting on its upper surface the bulb, which is a peculiar kind of bud. The bulb is found in perennial plants, and is a reservoir of nutritious matter for the new plant (which is contained in the centre of the bulb in the form of a bud), during the period when vegetation is suspended, and before the roots are able to draw sufficient nourishment for the development of the bud. The scales are thicker and more fleshy the nearer they

are to the centre, where the bud is lodged. The bulb was denominated by Linnæus, " the winter quarters of the future plant."—See par. 128.

52. The Wild Tulip (*Tulipa sylvestris*) throws out from its root a long stout fibre, at the extremity of which a bulb grows. This bulb or bud soon becomes an entire and independent plant, at a considerable distance from the parent. At the base of the bulbs of the Snow-drop (*Galanthus nivalis*), or Lily, may be observed small bulbs, which afterwards become detached from the parent, and form independent plants. Bulbs often grow on the stem, as in the Orange Lily, in which situation they are termed *bulbils*. (130.)

53. The bulb is sometimes simple, consisting of one bud, as in the Tulip or in the Squill; in other cases several small bulbs are united together, as in Garlic (*Allium sativum*).

54. The bulb is found chiefly in monocotyledonous plants (406).

55. Granulated Root. This root has numerous small tubercles, capable of reproducing the plant, but containing little nutritious matter: White Saxifrage (*Saxifraga granulata*).

56. This is sometimes called an *articulated root*, but this term is applied with more propriety to those having a jointed appearance, but without tubers.

57. Fibrous and fusiform roots are generally annual, but some tap-roots are biennial, as the Carrot; and a few of each kind are perennial. Creeping, Abrupt, Tuberous, Bulbous, and Granulated Roots, are always perennial.

58. Thus it will be observed that perennial plants,

which live during many seasons, have either a bulb, a tubercle, or a woody subterraneous stem, which preserves the vital principle during the suspension of vegetation, and contains a store of nutritious matter for the early growth of the new plant. A mere bundle of fibres would be unable to survive excessive cold or much moisture, could not contain a store of ready formed vegetable matter, and would not be adapted to convert readily the material drawn from the soil into proper nutritious matter. In every instance of the growth of a new plant, whether an entire plant from a seed, bulb, or bud, or herbage and flowers from a perennial root, there must be a stock of proper food ready for the young plant.

59. Almost all plants are provided with roots, except several of the lower orders, which, vegetating in water or on its surface, absorb nutritious matter at every point. Some plants which have roots float loosely in water, and are not fixed to any thing, as Duckweed (*Lemna*). Aquatic plants, however, have generally two roots; one is buried in the earth and fixes the plant; and the other floats freely in the water, as Buckbean (*Menyanthes*), and Water Lily (*Nymphæa*). The Sea-weed tribe (*Algæ*) are in general fixed to rocks, from which they can draw no nutritious matter.

60. Parasitical plants are those which insert their roots in other plants, and draw from them their nourishment: Broomrape (*Orobanche*), Dodder (*Cuscuta*), Misseltoe (*Viscum album*).

61. The root is formed by the growth of the radicle (414), the little conical body which is well seen be-

tween the cotyledons (405) of many dicotyledonous seeds, as the Pea or Bean. It has a natural tendency to grow downwards, which exerts itself in every instance, except perhaps in the Misseltoe, in which the radicle always grows in a direction perpendicular to the axis of the body on which it may be placed.

62. The structure of the root is generally similar to that of the stem. It is destitute, however, of pores or stomata, organs which would be useless on this part of the plant (90). It has no buds, or rather its buds do not develope as leaves, flowers, or branches, but as roots (121.); and it is said to be destitute of pith and of spiral vessels. Some eminent vegetable anatomists, however, have discovered spirals in several roots; but they certainly are more rare in the root.

63. All parts of the root possess the power of emitting rootlets, and hence the primary root divides into many branches under ground, in the same manner as the stem does in the air. The root is thus enabled to draw more nutritious matter for the support of the plant, having more absorbing mouths or spongioles, and the command of a greater extent of soil. One of the principal uses of ploughing is to crumble down and divide the masses of earth, and enable the rootlets more easily to penetrate into the soil.

64. Branches also possess this property of throwing out rootlets (121.): if a branch be placed in the earth, or surrounded with earth on the tree, an incision being made in the bark, it will emit rootlets from its sides, and become, if properly treated, an entire and independent tree; hence the propagation of plants by slips and by layers. Many of the Grasses, as Indian Corn (*Zea*

mays), and the Sugar Cane (*Saccharum officinarum*), emit from the knots on the stem, when these parts are surrounded with moist earth, rootlets capable of producing new plants. In this way the Sugar Cane is propagated.

65. The root, then, has two functions to perform, 1*st*, To fix the plant in the soil or to the substance on which it grows; 2*dly*, To absorb the nutritious matter necessary for the growth of the plant.

66. I must here again remind the reader of the double meaning of the word "root," and this will be best explained by an example: In the bulbous root, when we consider only the situation of the part, the root includes both the bulb or bud and the fibrous root below it; when we refer only to the function, the root is the bundle of small fibres which proceed from the lower part of the bulb. Although, in general, it is proper to consider as root only the radicles, which imbibe nourishment, and although, in many plants, a part which has the function of the stem bears improperly the name of root, we must still make a distinction between that part of the stem which emits no buds and that which does, and also between the parts above and below the collar or life-knot (28).

CHAP. II.—THE STEM (*CAULIS*).

67. THE Stem is an organ possessed by most plants. It grows upwards from the neck, gives support to the leaves, the flowers, and the fruit, and transmits to them the nutritious fluids absorbed in the earth. These, it

is most probable, undergo some change in their passage through the stem.

68. Almost all phenogamic or flowering vegetables are provided with stems. Those which are destitute of it, or in which it does not distinctly appear, are called *Acaules* *, as the Cowslip *(Primula veris)*. The organ which, in the Cowslip and Lily, appears to be the stem, is not a true stem, as it bears no leaves, but merely a flower-stalk springing from the root, and is called a scape *(scapus)* ; see par. 212.

69. With regard to function, all that part of the plant between the radicles and the leaves is stem, so that every plant is provided with a stem. In bulbous plants the bulb is the stem: it is the part which intervenes between the root (the fibres) and the leaves and flowers. When we consider merely their appearance, the stem and branches appear to be materially different; but if we attend to the structure and functions of these organs, it will be perceived that there is no material difference between them; the organization, mode of formation, and office, being exactly the same; the branches being merely productions of the stem, disposed in their peculiar form for the purpose of exposing a greater number of leaves to the action of air and light. In the ground the stem sends forth many branches, that it may be able to draw for support on a larger quantity of soil.

70. Linnæus divided stems into seven kinds; the Caulis, the Culmus, the Pedunculus, the Scapus, the

* In Botany, as in other sciences, the letter " a " prefixed to a word is called privative, and signifies " without."

Petiolus, the Frons, and the Stipes. Of these seven varieties, the pedunculus and the scapus belong to the reproductive organs, and the petiolus may be considered a part of the leaf; so that, in this place, only the caulis, culmus, frons, and stipes, need be alluded to.

I. CAULIS.

71. This, the most common kind of stem, includes the trunks of trees and the stalks of shrubs, and of most herbs. The stem is called—

72. *Creeping (repens)*, when it lies on the earth, and takes root in many points: Creeping Loosestrife or Moneywort *(Lysimachia Nummularia)*.

73. *Stoloniferous*, sarmentose or trailing, when the principal stem gives out laterally smaller ones capable of striking root and producing new plants: Strawberry *(Fragaria vesca)*; Common Bugle *(Ajuga reptans)*. These lateral stems are called stolons, runners, or scions.

74. *Stems are either Simple or Compound.*—When there are no marked ramifications, the stem is simple, as the Great Mullein *(Verbascum Thapsus)*, Foxglove *(Digitalis purpurea)*. It is compound when it divides into a greater or less number of branches.

II. CULMUS, OR CULM.

75. This kind of stem is peculiar to the Grasses, Cyperaceæ, and Junceæ. It is a simple stem, generally hollow, and divided at various distances by knots, from which sheathing leaves arise.

III. FRONS.

76. This kind of stem is composed of branch and leaf united together, and frequently joined to the fructification, as in Ferns *(Filices)*. The term *frons* was frequently used by the ancients to express a part of the wood with the leaf upon it, or a twig with leaves; and hence Linnæus applied it to the Palms, in which the branches are considered as leaves developed in a peculiar manner, and to the Ferns, in which the fructification is on the back of the leaf. The term is now used only for Cryptogamic plants, as the Lichens, Algæ, &c., or simple plants like Duckweed *(Lemna)*.

IV. STIPES.

77. This term is little used, except for the stem of the Palms, and of the Mushrooms *(Fungi)*.

78. The term *Rhizoma* is most properly applied to the subterraneous horizontal stems of perennial plants, mostly concealed in the earth, and shooting up new leaves from one extremity while the other perishes. Traces of the leaves of preceding seasons may be found on it, and it grows at the end next to the leaves: Common Solomon's Seal *(Convallaria multiflora)*. The rhizoma is found only in Monocotyledonous plants (406).

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79. With respect to Structure, stems may be divided into three great classes, which correspond with the three natural classes into which vegetables are divided, —Cellular, Endogenous, and Exogenous Stems.

I. CELLULAR STEMS.

80. These consist of a homogeneous mass of cellular vegetable matter, covered by a thin cuticle. Some of them are apparently of a fibrous texture, but are composed of elongated cells placed parallel to one another. Mushrooms *(Fungi)*, Lichens, and all the other lower orders of plants, except the Ferns and one or two others, make up this class, the leading character of which is to consist of cellular tissue alone. The Ferns, &c., however, being destitute of a particular order of vessels, the spirals, and resembling in other respects this class, have generally been included in it.

81. Plants of this kind are called *Cellular* by some, *Acotyledonous* by others, and Linnæus applied to them the term *Cryptogamic*. See 424-5.

II. ENDOGENOUS STEMS.

82. These consist of bundles of vessels irregularly dispersed through cellular tissue, and covered by a thin cuticle (88). The Sugar-cane *(Saccharum officinarum)*, the Lily, the Palm, and the Iris, have this kind of structure, the cellular and vascular tissues being blended together through the entire substance of the stem.

83. Stems of this kind are called *Endogenous*, because the new matter by which they increase in diameter is added at the centre. Their growth is carried on by means of the thick cluster of leaves by which they are terminated superiorly. From them the new matter descends into the centre of the stem, and pushes

outwards the parts first formed. The upper parts of the leaves perish, having performed their functions; their bases remain, are pressed together, and form the new external part of the stem. In the middle of the crown of leaves is the terminal bud, which is next to be developed, rise a little above the former, become a cluster of leaves, and in its turn be pushed outwards by a succeeding central bud.

84. The oldest and hardest part of such stems is that nearest to the circumference. The more the external parts are pressed by the descent of the new matter, the more close and compact they become, the outer parts being incapable of being much farther pushed out, and the whole being thus condensed into less bulk.

85. From the mode of growth in this stem it never can attain a great thickness, the new matter having to force outwards all the previously formed matter, which is every season increasing in quantity and becoming harder. They often, however, attain a very great height, as is seen in Palms, which are occasionally met with nearly 200 feet high.

86. Stems of this kind are found only in Monocotyledonous plants (406).

III. EXOGENOUS STEMS.

87. The third class of stems consists of those in which are observed concentric layers of vascular tissue, arranged symmetrically round a central column of cellular tissue, enclosed by a hollow cylinder of bark, and covered, in annuals, biennials, the annual stems of perennials, and the young stems or shoots of trees, by

a cuticle or epidermis. The parts which this kind of stem presents for consideration are,—1. The Epidermis; 2. The Cellular or Herbaceous Integument; 3. The Bark; 4. The Wood; 5. The Medulla or Pith.

1. *The Epidermis or Cuticle.*

88. The epidermis is a thin membrane, or, as some say, a layer of cellular tissue, which covers every part of the plant, extending from the delicate fibril of the root to the no less delicate leaf of the flower, over every organ except the anther and stigma. In young stems it is very distinct and entire, but when the trunk has increased much in size it is torn, as in the Elm, or falls off in patches, as in the Birch and in the Plane, and on the trunks of all trees is torn and cracked in every direction. It is much less prone to decomposition than the other parts of the vegetable, and is easily regenerated in a young stem, but never on leaves or on annual stems.

89. The cuticle is described by some as consisting of a layer of fine membrane provided with pores, and covering a sort of cellular network. These pores open by an oval aperture, surrounded by a small prominence (which is supposed to open or shut the aperture as circumstances may require), into small bags or vesicles in the cellular network, in which the vessels terminate. On the leaf the cuticle is a very important organ.

90. These pores or stomata give free passage to moisture. They are found only on parts exposed to the air, and which evaporate freely. Roots, fleshy fruits and seeds, and those parts of aquatic plants which

are submersed, are destitute of stomata. Water, or a moist atmosphere, closes the pores, as evaporation cannot then take place. In dry weather, or when the sun is shining, the pores are open.

91. The cuticle is supposed to protect the parts underneath from the too direct action of air and water, and to prevent too great evaporation of the fluids. It affords little protection from the action of heat or cold, except when covered by a thick hair or wool, as in the Great Mullein. On the trunks of the Fir, the Plane, the Oak, and other trees, the office of the cuticle seems to be performed by dead layers of bark or of herbaceous integument, which are pushed outwards, having performed the functions for which they were made.

92. "In forest trees, and in the larger shrubs, the bodies of which are firm and of a strong texture, it is a part of little importance; but in the reeds, the grasses, canes, and the plants having hollow stalks, it is of great use, and is exceedingly strong; and, by the microscope, seems composed of a kind of glassy network, which is principally siliceous earth. This is the case in Wheat, in the Oat, in different species of Equisetum, and, above all, in the Rattan, the epidermis of which contains a sufficient quantity of flint to give light when struck by steel. The siliceous epidermis serves as a support, protects the bark from the action of insects, and seems to perform a part in the economy of these feeble vegetable tribes, similar to that performed in the animal kingdom by the shell of the crustaceous insects. I have ascertained by experiment that siliceous earth generally exists in the epidermis of the hollow plants*."

* Sir Humphrey Davy's Agricultural Chemistry.

The Bamboo *(Arundo bambos)* contains much silica, called "tabasheer."

2. *Herbaceous or Cellular Integument.*

93. This is the layer of cellular tissue, which lies immediately under the epidermis, and gives to the leaves and young stems their green colour. It forms the substance of the leaf, and in it the changes effected on the sap by the atmosphere take place; hence it frequently contains the proper juices. It is easily repaired on the young stems of woody vegetables, but never on those of annual plants or on leaves.

3. *Liber, Cortex, or Bark.*

94. This is found immediately under the herbaceous integument, and consists of a vascular network, the spaces between the vessels being filled up by cellular tissue. Neither spiral nor porous vessels (20) are found in the bark; it contains only proper vessels.

95. The bark consists of concentric layers, each being composed of a layer of vascular tissue and one of cellular tissue. There is only one layer of each in young shoots one year old, and the layer of cellular tissue is external, or encloses the other. A new layer of each is formed in each succeeding year within the old one; and thus, in trees, the bark is made up of as many vascular layers as the tree is years old; the older layers being pushed outwards and destroyed by the growth of the new layers, and becoming a lifeless crust. Hence the bark may be called *endogenous*, or growing from within.

96. The proper juices and secretions of the plant re-

side chiefly in the bark, in the innermost layers; and hence it is principally from this part that we extract those vegetable principles so useful in medicine and in the arts.

97. In the newly formed layers of bark, the sap, which has been modified in the leaves by the action of the air, descends to nourish and promote the growth of the plant. The outer bark also serves the purpose of protecting the new layers of wood and bark from injury. The old and hardened layers form an excellent protection from external violence.

98. The bark, being the part in which the sap descends to supply the plant, is essential for its increase. If part of the bark be removed from a tree all round, so as to leave the wood bare, the part beneath will not grow, the medium by which the nutritious fluids were conveyed to it having been removed, and the tree will ultimately perish. A graft will not take if its bark be not in contact with that of the tree in which it is inserted; and a branch will not take root when surrounded with earth, if the part be deprived of its bark.

99. The bark is easily renewed when it has been destroyed, if the injury be not too severe, or too large a quantity removed; while the renovation is going on, it requires to be protected from the access of the air. The renewal of the bark takes place by means of the cambium (111), which exudes from the wood and edges of the wound, and gradually repairs the injury.

4. *The Wood.*

100. The wood lies immediately under the bark, and makes the principal bulk of the trunk and branches.

5. *The Pith or Medulla.*

106. The pith is contained in the *medullary sheath* or *canal*, which is in the centre of the tree, and the sides of which are composed of vessels, chiefly spiral, disposed in a longitudinal direction. In all plants the pith consists of cellular tissue alone, and is of a light and spongy character. The cells are, in general, very regular, and of an hexagonal form: in the young shoots of trees, and in herbaceous plants, these cells are filled with aqueous juices, which disappear as the plant grows older, and then they contain gas alone.

107. In herbs, and in some trees, the pith continues of the same diameter during the whole life of the plant; but, in trees, it is generally obliterated by the pressure of the woody layers. In many vegetables the pith disappears as the plant grows, and the stem becomes at last perfectly hollow, often, however, lined with a thin coating of pith resembling cotton. This is the case in many of the Umbelliferæ, as in Hemlock.

108. The pith, it is supposed, nourishes the young wood and the buds during the first year of their existence; and it has been observed that it retains its moisture for a longer period near the terminal bud, and at the parts where branches are given off.

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109. Such is the structure of the stems of that very large class of plants which constitutes the third division. They are found only in Dicotyledonous (408.) plants, and they are called *Exogenous*, because the wood, which is the principal part of them, increases in

diameter by the addition of new matter at its external surface (103).

110. In exogenous plants, the new matter being added externally, a bark or covering is necessary to protect it, when young and tender, from the action of the atmosphere, and from external injury from other causes: hence an important office of the bark. In endogenous plants, the new matter, being added internally, is provided with an excellent covering, formed of the main substance of the plant, and has no need of a separate protecting integument. Thus the endogenous plant is one uniform tissue from the circumference to the centre.

111. In spring there is found between the bark and the alburnum a viscid gelatinous fluid, called *cambium*, which, it is supposed, is the principal agent in forming the new layers of wood and of bark. This fluid is composed of the residue of the cambium of the preceding season, enriched and renewed by the descending sap, and mixed with some of the secretions of the vegetable.

112. M. Mirbel and others are of opinion that the cambium annually forms a new layer of alburnum and a new layer of bark. This is the most simple mode of formation, and probably that which takes place. We know that the cambium can repair the bark when it has been injured; and, as the new layers of wood and bark are formed where this fluid is found, it is not unreasonable to suppose that it acts an important part in this process.

113. M. Du Petit-Thouars advanced a singular theory, namely, that the successive formation of woody

It consists of concentric layers, each of which is composed of a layer of cellular tissue and one of vascular tissue. In young shoots, one year old, there is only one layer of vascular tissue, which lies upon the medullary sheath (106). In each succeeding year there are two layers formed, one of cellular tissue and one of vascular tissue, of which the latter is the external. Hence the age of a stem of this kind may be known by the number of concentric vascular cylinders in the wood; this is easily seen, as the layers of cellular tissue which intervene between the layers of vascular tissue render the latter very distinct.

101. The external woody layers next the bark are called the *alburnum*, and differ from the internal layers or true wood in being younger, softer, more succulent, and of a lighter colour.

102. The true wood is formed by the inner layers of the alburnum, which gradually acquire a greater degree of hardness: the transition from alburnum to true wood is, however, almost imperceptible.

103. To supply the place of the alburnum, which is thus altered, a new layer (consisting of a layer of cellular tissue and one of vascular tissue) is formed annually next the bark: it is pushed inwards, and becomes more compact by the pressure of each succeeding annual layer, till at last it becomes almost solid, the sides of the vessels and cells being squeezed close together: hence the greater hardness of such trees in the centre. Thus the wood in such stems is *exogenous*, or growing from without.

104. The fasciculi or bundle of vessels which compose the cylindrical layers are separated at different

points by masses of cellular tissue, extending from the centre or pith (106.) towards the circumference, causing an appearance of alternate rays of vessels and cellular tissue. These are called MEDULLARY RAYS (from their radiated appearance), medullary prolongations, or insertions. The use of the medullary rays is unknown. It has been conjectured that they serve for the horizontal diffusion of the fluids.

105. The wood gives passage to the sap from the root to the buds and leaves, and contains many of the secretions of the plant. It has been supposed that part of the sap rises through that part of the wood next to the pith (the medullary sheath), and is conveyed thence to the buds, being somewhat altered in its properties during its course, and rendered fit for promoting the growth and evolution of the leaves; and that the rest of the sap rises through the alburnum (the vessels of which, being young, soft, and not compressed, are well adapted for the passage of fluids), and is conveyed to the leaves when formed, there to undergo changes which render it fit to promote the growth of the plant. Little is known with respect to the particular functions of each part of the wood, excepting the alburnum, the latest formed layer of which gives passage upwards to the sap. Thus it would seem that the new layer of alburnum is formed for the nourishment of the plant, by conveying the sap to the leaves; and this explains why a serious injury of this part is so fatal. When it is destroyed, its office is very imperfectly performed by an old layer, filled with secretions, or hardened, and with the vessels contracted by pressure.

while those whose tissue is dense require a much longer period to attain any considerable size, as the Oak and Elm: but the latter are capable of acquiring a much greater size and thickness than the former. Adanson mentions having seen in the Cape Verd Islands some Baobabs about 30 feet in diameter, or nearly 100 feet in circumference. These are the largest trees in the world. Heat and moisture enable trees to grow to a considerable magnitude; and hence the largest trees are found in tropical climes.

CHAP. III.—BUDS.

120. Buds are those little bodies which grow on the surfaces of vegetables, and contain, in a dormant, or rather latent state, the germ or rudiment of an entire plant, or of part of a plant, ready to be developed when the season is favourable, and capable of growing or being enlarged in two opposite directions (27). They are the first results of vegetation, and the leaves, branches, and flowers are at first contained in buds. The period of their evolution depends principally on the warmth of the season. Those in a hot-house, or in a warm exposure, are first developed. Severe cold destroys them altogether.

121. It is the opinion of many botanists, that germs or rudiments of buds exist within the plant, and are formed at the same time as the stem and branches; that those only become developed which meet with an abundant supply of sap, arising from some obstruction in its course, which causes it to accumulate; that they

develope as leaves and branches, or as roots, according to the medium in which they shoot, becoming buds (generally so called) when exposed to light and air, and roots when they strike into the earth; and that the buds arise at the axilla of the leaf (between the leaf and the stem, at the angle formed by their meeting), because the branching off of the fibres of the leaf from the stem impedes the sap in its course at these particular parts. A bud may be observed in the axilla of every leaf.

122. If a young tree be inverted, the branches being placed in the earth, it will live: roots will come from the buried branches, and leaves and flowers from the roots. In this case the branches are not changed into roots, nor the roots into branches; but the undeveloped buds or germs in the roots become branches, &c. when exposed to the atmosphere; while those of the branches become radicles or rootlets, when developed in the earth.

123. M. Richard enumerates five distinct kinds of buds: the Proper or Common Bud, the Turio, the Bulb, the Tubercle, and the Bulbil.

124. *The Proper buds* are those commonly called buds, found upon the branches of trees, arbuscles, or shrubs, in the axilla of the leaf, or at the extremity of the twig. They are composed of scales enveloping each other, and frequently, in trees of our climate, covered with a viscid resinous substance, and having a downy texture within, for the purpose of protecting them from cold. These scales consist of leaves similar to those to be afterwards developed, but checked and almost blasted by being put forth before there

layers is caused by the development of buds, from which, in spring, issue numerous fibres, which descend in the cambium between the liber and the alburnum. In gliding downwards they meet the fibres which descend from other buds, and form a layer of greater or less thickness, which soon becomes solid, and forms a layer of wood.

114. Each bud is regarded as a separate system of vegetation. The buds are considered so many individuals placed upon a common stock, and elongating in two ways—upwards, forming new stems and branches, leaves, &c.—and downwards, forming roots; the descending fibres being the roots which the buds put forth, and the cambium bearing the same relation to the roots of the bud as the soil does to a germinating seed. M. Thouars considers buds as analogous in structure and mode of development to the embryo of the seed, which in germinating produces a young stem analogous to the scion produced by the growth of a bud. He calls the latter a *fixed or adherent embryo*, while he denominates that within the seed a *free embryo*. Thus the wood and bark are considered as formed of the roots of the buds which are annually developed on the surface of the vegetable.

115. Grew, Malpighi, and Duhamel, supposed that the cambium forms annually a layer of liber, which separates into two layers—an external one, which becomes bark—and an internal one, which is converted into alburnum. A new cambium exudes from the outer surface of the internal layer, and forms a new liber, which undergoes similar changes. "Every year," says Grew, "the bark of a tree is divided into two

parts, and distributed two contrary ways: the outer part falleth off towards the skin, and at length becomes skin itself; the inmost portion of the bark is annually distributed and added to the wood." This opinion is now abandoned, and the only theories now adopted are those of MM. Mirbel and Thouars.

116. Whatever may be the mode in which the formation of the new layers takes place, it is known that the new matter which forms them *descends* from the leaf buds or leaves, either in the innermost layers of the bark, or between it and the alburnum.

117. If all the buds or leaves be removed from the upper part of a branch, no increase in diameter will take place above those that are left. If a ring of bark be removed from a tree, the part below will not increase in thickness, and the upper lip of the wound will heal quickly, while the lower lip will not. This operation has been recommended for improving the fruit of trees; the descending sap or cambium, being confined to the upper part, increases the size of and enriches the flowers and fruit developed above the place from which the ring has been removed. This is called ringing; care must be taken to make the ring very narrow, in order that the parts may easily reunite: See par. 98.

118. If a ligature be placed tightly round the bark of a tree, the part above the ligature will swell, but not the part below; and it has been observed that the rate of increase of the diameter of any part of a branch or tree is in proportion to the number of leaf-buds developed above that part.

119. Those trees which have a light spongy texture, as the Poplar and the Willow, grow very rapidly;

is a sufficient degree of warmth in the atmosphere. They shrink, harden, and form an excellent protection, till the season is more favourable, for the more internal leaves, which, if exposed while too young and tender, would undergo the same fate. In trees growing in warm climates, these external scales are often absent, the leaf expanding without any such protection, as in the Horse-chestnut (*Æsculus*) in India: in this country its buds are enveloped by a great number of scales.

125. They are formed in summer, when vegetation is vigorous, and the sap flows freely in the plant, grow a little in autumn, and remain stationary during the winter. In spring, they partake of the general impulse which vegetation receives from the increased heat of the earth and atmosphere, and begin to expand; they become gradually enlarged; their scales, or hybernacula, are pushed aside, and the organs they protected begin to appear. In warm countries where vegetation is more vigorous, and the sap flows freely during the whole year, there is less interval between their formation and evolution. In the axilla of every leaf, however young, though still in the bud, a small conical pointed body may be observed: this is the rudiment of the bud of the succeeding season, thus apparent more than twelve months before it is to be developed.

126. Those which are long and pointed generally produce leaves and branches, and are called *foliiferous.* Those which are larger and more rounded contain flowers, and are called *floriferous.* Some contain both leaves and flowers, and are called *mixt,* as Lilac (*Syringa vulgaris*).

127. *The Turio* is the bud of perennial roots, grow-

ing from the upper part of the root, and producing the new stem (37).

128. *The Bulb* has been described under the term "bulbous root" (50). It may be considered as a bud, because it contains the rudiment of the future plant; but if we consider it with regard to function, it may, perhaps, with more propriety be viewed as a stem with a bud, as it contains nutritious matter for the develop ment and growth of this bud (69). Hence, in plants with bulbous roots, the virtues are found in the bulb, as in Onion, Garlic, Squill, &c.

129. *The Tubercle* has been described under the term "tuberous root" (46). It may be considered a short, fleshy, subterraneous stem, the eyes on its surface being analogous to the buds on the stem.

130. "*Bulbils*," says Richard, "are a species of small solid or scaly buds, growing on different parts of the plant, and capable of independent vegetation, that is, being detached from the mother plant, they become developed, and produce a vegetable perfectly similar to that which gave them birth. Plants which produce buds of this kind are called *viviparous*."—"These are either produced in the axilla of the leaves, as in the Orange Lily (*Lilium bulbiferum*), or they are developed in the place of the flowers, as in the Mountain Garlic (*Allium carinatum*)."—Nouveaux Elemens de Botanique, p. 117.

131. M. Richard considers sporules, the small bodies which are developed in different parts of Ferns, Mosses, Lichens, &c., as true bulbils; being destitute of the radicle (414), the gemmule (413), and the cotyledon

(405), to possess which he considers as an essential character of the true seed.

132. Endogenous plants seldom produce more than two or three buds, and frequently only one bud annually, as in the Palm, the bud of which has the appearance of a cabbage, and in the Onion, and other bulbous plants. Exogenous plants have a great many buds. Annual and biennial plants do not produce buds: they bear a plentiful supply of seeds for the purpose of propagation.

CHAP. IV.—LEAVES.

133. Leaves are flat greenish organs, of various shapes, growing from the stem or branches; at first they are concealed in buds, but, as the season advances, they are gradually unfolded, and come forth expanded, presenting a large surface for the action of air and light.

134. Leaves are formed by an expansion of the fibres of the stem at particular parts. These fibres are bundles of vessels, chiefly spiral and proper vessels, which by their ramification form a network, or skeleton, which is filled up by cellular tissue, continuous with the herbaceous integument of the stem. The whole is covered by the cuticle. The spiral vessels are supposed to be derived chiefly from the medullary sheath; while the proper vessels are continuous with the bark. Many of the vessels must be continuous with the alburnum.

135. When the bundle of fibres spread out immediately on leaving the stem, the leaf is called *sessile*, as

in the White Poppy (*Papaver somniferum*). See Fig. 7, the leaf of Horned Poppy (*Glaucium luteum*).

Fig. 7.

136. When the fibres are clustered together for a little way before they expand, they constitute what is called a *petiole* or footstalk, as in the Horse-chestnut, (*Æsculus hippocastanum*), and most trees. Hence the leaf has been divided into the petiole, and the lamina or disc, the leafy part. See Fig. 8, the leaf of Black Bryony (*Tamus communis*).

Fig. 8.

137. In some cases, as in the simple leaves of the Mimosæ of New Holland, the lamina is not developed, and the petiole becomes expanded, or leafy, in which case it is called *phyllodium*.

138. The projecting lines seen on the under surface of the leaf, and called veins or nerves, are the ramifications of the vascular fibres which proceed from the stem. They terminate in the surface of the leaf by a pore or stoma (89).

139. Most leaves are divided into two lateral halves by a large vein extending from the base to the summit. This is a continuation of the petiole, and is called the *midrib*. From its base and sides the other veins proceed and spread in all directions. See Frontispiece, Fig. 4, the leaf of the Common Primrose.

140. In the leaves of most exogenous (109) or dicotyledonous plants (408), the veins form a kind of network, leaving the midrib abruptly, branching irregularly among the cellular tissue, and uniting frequently with each other. See Fig. 4.

141. In the leaves of most endogenous (82-3) or monocotyledonous plants (406), the veins proceed directly from the base to the apex, or diverge gradually from the midrib, are little ramified, placed parallel to each other, and connected by simple transverse veins. See Frontispiece, Fig. 3, the leaf of Lady's Slipper one of the *Orchideæ*.

Leaves are either *simple* or *compound*

142. In a simple leaf (Fig. 8, page 44), the petiole is undivided, and the lamina or disc consists of a single piece. The simple leaf, when divided deeply, somewhat resembles the compound leaf: in the simple leaf,

however, each division is continuous in its leafy part with the leafy parts of the divisions on each side, so that we cannot completely separate one division without tearing more or less those between which it is situated.

143. A compound leaf (*compositum*), consists of several leaves or leaflets (*foliola*) attached to a common petiole (*rachis*), and quite distinct from each other in every part, so that one may be detached without injuring any of the others. See Fig. 9, par. 157. Buds are not found in the axillæ (121) of the leaflets of compound leaves. In them they occur only at the base of the common petiole; and the whole is considered as only one leaf. The branches of the petiole or petioles of the leaflets are called *petiolets*, or secondary petioles. Sometimes the petiolet, or rather the leaflet, is compound, in which case the whole leaf is called *decompound*. And when the leaflets arise from the tertiary petioles, or branches of the secondary petioles, the leaf is called *supra decompound*.

According to their Duration on the stem, the leaves are,

144. *Caducous*, when they fall early, as in the Plane-tree.

145. *Deciduous*, when they fall before the new leaf appears, as in the Horse-chestnut and most other trees.

146. *Marcescent*, when they wither before falling, as in the Oak and many other trees.

147. *Persistent*, or *Evergreen* (*Sempervirens*), when they remain on the vegetable one winter or longer, as the Ivy, the Pine, the Myrtle, the Common Laurel, &c. Plants of this kind are called Evergreens.

148. In the generality of plants the leaves annually decay, and are reproduced in the spring. It is supposed that before the leaf falls there is a kind of joint formed between it and the stem. This is effected by the deposition of hard matter, and by the drying and shrinking of their tissue at their junction with the stem. In very warm climates their decay occurs at the conclusion of the summer, when, from the dryness of the soil, and the evaporation caused by the excessive heat, they are scantily supplied with sap. In temperate climes their fall takes place in autumn, when the weather is becoming colder. Their fall is, of course, always preceded by the cessation of the circulation in them. This may be partly the effect of their decay from exhaustion, but it is most probably the principal cause of that decay. Leaves with the petioles jointed on the stem fall first; next, those of which the petioles are not jointed; and, lastly, those which are sessile.

149. Plants which are destitute of leaves are called *aphyllæ:* Glass-wort (*Salicornia*), Dodder (*Cuscuta*).

150. There are two sets of veins or vessels in the leaf; one proceeding to the upper surface from the stem, and conveying from it the sap for the purpose of being exposed to the action of air and light. This surface is, in trees and shrubs, constantly turned to the light, and is said to be destitute of pores or stomata, The other set of vessels proceeds from the lower surface of the leaf to the bark, and conveys to it the sap, now rendered fit for the nutrition of the plant. If the leaves of a branch be placed so that the upper surface be turned towards the earth, they will gradually re-

sume their natural position; and if prevented from doing this, they will wither and die.

151. The under surface abounds with stomata, through which the watery part of the sap passes off in vapour. In aquatic plants the upper surfaces of those leaves which float on water are provided with most stomata, for the purpose of evaporation, as this process cannot take place in water.

152. The leaves of succulent plants, such as the Cactus and the Aloe, are provided with few pores, and evaporate very slowly, and may be considered as reservoirs of nutritious matter for the use of the plant; in great heats, and in a dry soil, preserving its existence by their power of retaining the fluids which are absorbed. Plants which grow in dry and parched situations, where supplies of rain are very scarce, have leaves of this kind. The thin small leaves of the Fir are of an opposite nature, being provided with numerous pores, and evaporating freely.

153. The leaves, it has been supposed, have the power of lowering their temperature in the night, by which they condense the watery vapour in the atmosphere; it is then absorbed in the form of dew. In grasses and other herbaceous plants, the leaves of which grow vertically, and have their opposite surfaces much alike in appearance, the absorption of nutritive matter from water, or from the vapour diffused through the atmosphere, is carried on indifferently by either surface. In trees, the leaves of which have distinct upper and under surfaces, differing from each other also in appearance, this absorption is carried on only by the under surface.

154. This was ascertained by Bonnet, who laid water alternately on both surfaces of the leaves of many trees and herbs, and found that those of the trees lived longest when their inferior surfaces were laid on the water; while those of some of the herbs lived equally well with either surface applied to the water, and of other herbs, the leaves throve best with their upper surfaces next the water.

155. Some leaves have the power of producing from their margins buds capable of becoming new plants. The seeds or buds of the Ferns (*Filices*) are produced in this situation. The Bryophyllum and the Marsh Bog-orchis (*Malaxis paludosa, Ophrys p.* Linn.) also produce buds from the margins of their leaves. The buds on the Malaxis are in the form of papillæ, at the extremity of the leaf.

156. Thus, it will be seen that leaves are organs of great importance in the vegetable economy: they absorb nutritious matter from the vapour and other gases diffused through the atmosphere; discharge the watery part of the sap by evaporation; and expose it to the action of air and light, by which it is rendered fit for the nutrition of the vegetable. See 189, &c. Hence the virtues of plants frequently reside in their leaves.

CHAP. V.—APPENDAGES.

157. STIPULES. The stipules are small leafy appendages at the base of a petiole or sessile leaf, of the same structure as the leaf to which they are appended, but frequently of a different figure. (See Fig. 9, the leaf of White Dog-Rose.) The leafy appendages, winging the lower part of the petiole, are the stipules.

Fig. 9.

158. They are never found in Monocotyledonous plants, but occur frequently in the Leguminosæ and Rosaceæ, and almost always in the Betulineæ, Saliciueæ, Magnoliaceæ, and in the exotic genera of the Rubiaceæ.

159. When the margins of the stipules adhere so as to form a leafy sheath round the stem, they form what is called an *Ochrea,* as in the Polygoneæ.

160. TENDRILS (*Cirrhi*). Thread-like appendages,

generally found in plants which have feeble stems, unable to support themselves, as the Pea, the Vine, the Vetch, &c. They wind spirally round neighbouring bodies, and thus support the plant.

161. They are supposed to be abortive petioles (136), peduncles (211), or branches;—petioles in the Pea and the Vetch, peduncles or racemes (233) in the Vine. In some species of Smilax they are considered abortive stipules.

162. Spines or Thorns. Sharp-pointed organs, which arise from the woody or internal part of the vegetable. They are supposed to be abortive buds, as in the Sloe-tree, the thorns of which are converted into branches if it be transplanted to a rich soil.

163. Prickles (*Aculei*) arise from the bark only, and can be easily detached, as in Rose, Bramble, &c.

164. Glands, minute globular bodies observed in many parts of the plant, as at the base of the sexual organs in the Cruciferæ, destined to secrete a particular juice from the general mass of fluids. This name is also applied to the receptacles filled with essential oil in many parts of the Aurantiaceæ, and particularly in the leaves of the Myrtaceæ and Labiatæ. These are called vesicular glands, and may be easily seen in the leaves of the Myrtle and of the Orange, giving them a dotted appearance. The Ice-plant takes its name from the number of glands on its surface, filled with a clear, colourless, transparent liquid.

165. Hairs are found chiefly on plants which grow in dry situations, and in these cases it is thought that they enlarge the absorbing surface. They are not found on very succulent or on aquatic plants. In many

plants the hairs are the excretory ducts of glands, as in the Nettle *(Urtica)*, the hairs of which irritate the skin by pouring in an acrid fluid. When very thickly set, they protect from the effects of too great heat or cold, as in the Great Mullein.

CHAP. VI.—NUTRITION IN VEGETABLES.

166. Vegetables consist principally of carbon (charcoal), oxygen, and hydrogen; they also contain small quantities of nitrogen, lime, magnesia, &c. They derive the principal part of their nourishment from the soil. The porous extremities of the rootlets absorb the fluids with which they come into contact. These fluids consist chiefly of water, holding in solution decayed animal and vegetable substances, and various earthy matters, as lime, alumina, magnesia, silex, potassa, and soda.

167. The animal and vegetable matters are essential, forming the main substance of the food of the plant. Hence lands which have been covered with wood afford excellent crops. The action of the earthy matters on the plant is not so well ascertained. It is most probable that they act as a stimulus to the absorbing fibres of the root; and within the plant, as a condiment, by their stimulating properties assisting to keep up the action of the solids in elaborating the food; and also forming an important part of the secretions. In the soil the different earths and salts assist in decomposing the animal and vegetable remains.

168. The food of vegetables must always be taken

in a fluid form, as the spongioles are incapable of absorbing solid matter. Hence there is no need of teeth for the purpose of masticating the food. The spongioles cannot continue long to absorb a thick or viscid fluid, as they would be clogged up by it, and hence a plentiful supply of water is necessary. Water also affords two of the most necessary elements of vegetable matter, oxygen and hydrogen; and when there is a deficiency of decayed organic matter, the water derived from the atmosphere must be the principal source from which these elements are procured.

169. Four kinds of earth are generally found in soils: alumina, argil, or clay; sand or silex; lime or calcareous earth; and magnesia. These constitute two principal kinds of soils; stiff, from an excess of clay, or what is called argillaceous; or dry, loose, and sandy, from an excess of siliceous matter.

170. "The silica in soils is usually combined with alumina and oxide of iron, or with alumina, lime, magnesia, and oxide of iron, forming gravel and sand of different degrees of fineness. The carbonate of lime is usually in an impalpable form, but sometimes in the state of calcareous sand. The magnesia, if not combined with the gravel and sand of soil, is in a fine powder united to carbonic acid. The impalpable part of the soil, which is usually called clay or loam, consists of silica, alumina, lime, and magnesia."—"The vegetable and animal matters are sometimes fibrous, sometimes entirely broken down and mixed with the soil *."

171. A stiff argillaceous soil opposes the entrance of air to the seed, the free growth and penetration of

* Sir H. Davy's Agricultural Chemistry.

the roots, and retains a great deal of moisture, which enfeebles the roots, and renders the crops which grow in it insipid, watery, or dropsical. It requires to be mixed with a light dry earth, and to be frequently turned up by the plough that the clods may be broken down and pulverised. The deficiency of silex in this kind of soil is also another cause why crops grown in it are weak and feeble (92).

172. A loose sandy soil does not retain the moisture afforded by the rain, which is so essential to the growth of the plant; and, owing to its want of cohesion, cannot fix the plant, so that when young it is liable to be rooted up by the winds. Besides these mechanical bad effects of a loose sandy soil, it is also inadequate to the growth of crops from the absence of lime and alumina, which, there is every reason to suppose, exert such a beneficial agency on the plant (167). From these causes, this kind of soil is also deficient in natural vegetable productions, the remains of which afford, in good soils, so large a proportion of the food of the plant. A soil such as this must be improved by the admixture of argillaceous and calcareous earth, and must be well manured, or have a crop of some light vegetable ploughed in with it, before it can be considered as fit for the production of a good crop.

173. Besides these, there are many other circumstances which affect the productiveness of soils; such as, the facility with which they are heated by the rays of the sun; the length of time they retain their heat; their power of absorbing moisture from the air; the degree of evaporation from their surface; their power in acting upon, combining with, and retaining the or-

ganized matter in the soil, which is greatest in rich soils, those which contain much alumina and carbonate of lime, and least in sandy soils, in which the organic matters, not being attracted by the soil, are decomposed by the air, or dissolved and removed by water; the nature of the subsoil; and many others, upon which it would be out of place to insist here.

174. Marl is a compound of clay and calcareous earth; and it is called argillaceous or calcareous, according as clay or lime predominates in its composition. It is of great value for the improvement of soil; argillaceous marl rendering a loose sandy soil more fit for the growth of vegetables, and calcareous marl performing the same office to a stiff argillaceous soil.

175. Lime is of great value in the improvement of soils. By its caustic nature, or its affinity for carbonic acid and water, it assists in decomposing the various organic matters in the soil; it acts as a stimulus to the absorbents of the root; and, by its firmness and cohesive properties, while at the same time it is not stiff and tenacious, forms an excellent addition to either a sandy or an argillaceous soil. It is particularly adapted to thin marshy soils, which are unable to retain the organic matters which are decomposed. Marl, by the quantity of calcareous earth which it contains, acts in the same way as lime, though less vigorously.

176. Ploughing breaks down the earth (63); exposes it and the various organic substances in the soil to the action of the atmosphere, the oxygen in which aids in the decomposition of any organized matter which may be present; and mixes thoroughly the different ingredients in the soil.

177. Manure enriches the soil by supplying the most essential matter for the nutrition of vegetables, decayed animal and vegetable matter. Soils which have become exhausted, that is, which have been deprived of their organic ingredients by a succession of crops, require to be invigorated by the admixture of more organic substances. This is done by means of manure, which is composed of the necessary material,—carbon, oxygen, and hydrogen, &c., and in which the putrefactive process has made such progress, that it is in an apt state for having its cohesion destroyed, and being reduced to its pristine elements. It is rendered soluble in water, in which state it is ready for being assimilated to the vegetable tissue.

178. This decomposition of the organic substances in the soil is effected partly by means of the water and other agents present there, and by the air (assisted by the influence of heat), and partly by the reaction of the elements on each other, or putrefaction. The water also acts the part of a solvent (168). Owing to the presence of nitrogen, and their more complex nature, animal substances are soonest decomposed. Vegetable substances, though more tardily, ultimately yield to the same agencies.

179. It has been observed that many plants excrete from their roots a peculiar matter which varies in the different kinds of plants. This matter, it is probable, consists of those parts of the sap which are not adapted for the nourishment of the vegetable, and which have been absorbed along with the nutritious particles, as the spongioles, it is supposed, have not the power of distinguishing between the different substances that

ascends through the medullary sheath is destined for the nourishment of the young buds, and that it undergoes some change in passing to them from the sheath.

187. The greater part of the sap ascends through the alburnum to the full grown leaves, which afford it an outlet by evaporating part of it, and sending the rest through the proper vessels to the bark, thus consuming rapidly what they receive.

188. The cause of the ascent of the sap is not well ascertained. Some have ascribed it to the influence of heat, others to capillary attraction. It seems to depend upon some principle not connected with the vital properties of plants: it has been found that if a root full of moisture be surrounded with very dry earth, the fluid will pass from the root into the latter; and the known effects of heat would seem to corroborate this opinion. It has been ascribed to a vital irritability in the vessels, to the influence of electricity, and by M. Dutrochet to *Endosmose*. This celebrated physiologist found that mucilaginous fluids have the property of overcoming the power of gravity, and ascending in small tubes with a force capable even of overcoming the pressure of the atmosphere, when in contact with membrane or other organized tissue closing the bottom of the tube; the fluid gradually works its way through the membrane or other tissue, and ascends to a great height in the tube. To this phenomenon he gave the name of Endosmose, and applied it to the explanation of the ascent of the sap in vegetables.

189. The sap, when it arrives at the leaves, is deprived of its watery part by exhalation or evaporation, this being dissolved in the atmosphere when it comes

into contact with it. This takes place principally under the influence of light and heat. Hot and dry weather greatly facilitates this operation, as Hales ascertained by experiments on the Sunflower (*Helianthus annuus*), which was found in such weather to transpire thirty ounces daily, being one-half more than its average quantity. The watery part of the sap, having performed its office of dissolving the solid matter necessary for the nutrition of the plant, thus rendering it fit to be absorbed by the spongioles, is discharged as of no further use.

190. This transpiration sometimes becomes sensible, as in cabbage leaves, and at the summit of the leaves of many of the Grasses. This is observed chiefly in the morning, the vapour having been condensed by the cold during the night; the first rays of the sun, however, cause evaporation to take place, and continue during the day to preserve the exhaled vapour in a gaseous form. A field of young corn presents a beautiful sparkling appearance in a cool dull evening, the tip of every leaf being surmounted by a glittering drop of condensed transpiration. Heat seems to have the power of opening the stomata, and thus facilitating the evaporation.

191. An important operation, it is supposed, is carried on by the leaves when under the influence of light. They exhale oxygen gas, derived from the carbonic acid in the atmosphere, and from that conveyed to them in the sap. The carbon is retained, being an important element in the composition of vegetables. Light, then, it is generally believed, causes the accumulation of carbon, and the expulsion of oxygen.

are presented to them, but absorb promiscuously all fluids with which they come into contact.

180. This matter, being rejected by the vegetable, must therefore be injurious, or at least of no use, to a vegetable of the same kind; and hence a succession of crops of the same plant, or even of the same family of plants, become gradually degenerated and of an inferior quality; while, on the other hand, any crop or succession of crops is followed with advantage by a crop of another family, as it is found that it can make a good use of the exudation from the roots of the former.

181. This excretion from the roots may be considered a kind of manure, calculated, however, to be beneficial only to plants of a family different from that which produced it; and this is a principle capable of a most important and extensive application in agriculture, as, by a judicious succession of crops, we are enabled to provide from each crop a sort of manure for that which is to succeed it.

182. The fluids thus absorbed undergo some modification in their course from the fibrils of the root to the stem, being most probably acted upon by the secretions of the plant which they meet. They then become what is called *sap*, a watery sweetish fluid, containing various salts, the organic matter which has been absorbed transformed into mucilage and sugar, and a large proportion of water (495).

183. The sap is found in the woody part of the stem, through which it begins to ascend towards the branches early in spring. At this period it may be easily col-

lected by piercing the woody parts in the Vine, Birch, or Maple, when it will flow out in great abundance. It rises or falls in the vessels according to the temperature of the atmosphere, heat distending the vessels, and promoting the free and vigorous circulation of the sap, and being perhaps the first stimulus to its ascent in the spring. It has long been a matter of dispute through what organs in the wood the sap rises, whether by the cells, the vessels, or the intercellular canals (17). It is difficult to conceive how the sap can pass through the cells so rapidly as we know it sometimes ascends in the tree. The intercellular canals also, from their not being regularly continuous, must offer considerable difficulties; it is most probable that the vessels are the organs which convey the sap upwards: they seem best fitted for this purpose.

184. By promoting the flow of the sap, heat is favourable to the growth of plants, and their vegetation is often accelerated by the application of artificial heat, which is called *forcing*. The greater size, and quicker and more vigorous growth of vegetables in tropical climates, is owing partly to this cause and partly to the influence of light, to which they are more exposed in such countries (196).

185. When the buds are developed and have put forth their leaves, they cause the sap to flow more equally and steadily, by constantly consuming what is presented to them; and if the wood be now pierced, little or no effusion of sap takes place, the leaves drawing it towards them as it is required, and removing large quantities of the watery part by evaporation.

186. It is supposed that that part of the sap which

stance. Saussure made plants vegetate in water and in an atmosphere, both of which were completely deprived of carbonic acid, and found that they did not thrive; but if carbonic acid were in the atmosphere, they flourished and arrived at maturity. Plants have been made to grow in dried earth, in flowers of sulphur, in a soil made of pounded glass and quartz, in all of which they could procure no carbon, which must consequently have been derived from the atmosphere. When a newly-formed or barren soil is first beginning to be clothed with vegetation, the oxygen, hydrogen, and carbon must be derived solely from the atmosphere; and it is only by drawing largely from this source, through the medium of the vegetables growing upon them, that soils can at last become able to support the growth of more perfect vegetables.

196. Light, it is also known, is absolutely necessary for the healthy existence of the plant, and its operation, when it is in full power, seems to consist in causing carbon to be deposited, as plants grown in the dark are tender, feeble, and insipid, wanting many of those properties which, it is probable, must depend on the presence of carbon. If a plant be kept in the dark or etiolated, the green parts become of a sickly white colour, and indeed the whole plant becomes soft and feeble. There is a deficiency of carbon, which is necessary to the firmness and stability of the plant and the development of the green colour. This is well seen in the Garden or Heading Cabbage, the internal leaves of which are white and tender, while the external ones are strong and fibrous, and have the green colour properly developed. When vegetation proceeds in the dark, the plant loses its peculiar virtues, and all

the fluids are nearly alike, possessing a mild sweetish taste. Too much light, or great intensity of light, by increasing the evaporation and the accumulation of carbon, renders all the parts of the plant more solid, stiff, and hard, and thus impedes its free growth.

197. These considerations, then, viewed by themselves, and in the absence of any decisive experiments, would seem to lead to the opinion, that plants do gain carbon by their action on the air. It may be observed, on the other hand, that vegetables can, in most cases, acquire a sufficient quantity of carbon in the soil, and that, when there is a sufficient provision for any end from one source, it is not likely that there should be another means constantly in operation conducing to the same end. This objection gains still more weight when we consider that leaves actually do, in certain circumstances, give out carbon (in the form of carbonic acid); rather an anomaly if they also take it in. Did we find that vegetables only take in carbon from the air when they cannot find it in the soil, in the same manner as they absorb moisture from the atmosphere when they cannot procure it by their roots, we should be enabled to form a rational theory of vegetable respiration. It is possible that this may be the case, and that, in some of the experiments which have been made, there may have been a deficiency of carbon in the sap of the plant, which might lead to the absorption of carbon from the air, while this might not be the case in others.

198. It has been supposed that the expulsion of carbon may be for the purpose of relieving the plant from an excess of this substance; and if it be allowed that the nature of the action which goes on in the leaf be

192. During the absence of light, in the night-time, a very different process is carried on: the leaves absorb oxygen, and give out carbonic acid.

193. The action of the leaves of plants on the atmosphere is a subject which is still involved in considerable obscurity. The experiments of Priestley, who discovered that leaves exert an action on the atmosphere, were supposed to shew that the general effect of vegetable respiration is the addition of oxygen to the atmosphere. From an extensive and interesting series of experiments instituted on this subject, Mr Daniel Ellis was of opinion that plants consume more oxygen than they give out, and add to the carbonic acid in the atmosphere; and that they do not derive carbon from the action of the leaf on the air. Subsequently, Sir Humphry Davy was led from some experiments to adopt Priestley's opinion, that plants purify, or add to the oxygen of the atmosphere, gaining carbon from that source. There is still wanting a series of experiments sufficiently varied and accurate to enable us to pronounce upon this point.

194. It would appear, if we attempt to draw any conclusion from the experiments at present known, that, in clear sunshine, plants decompose carbonic acid derived from the sap or from that in the air, retain the carbon, and give out the oxygen; that in diffuse daylight or cloudy weather, they sometimes perform this process, and sometimes give out carbon, which unites with the oxygen of the air, and forms carbonic acid; and that during the complete absence of light, they mostly perform the latter process. This, however, is such an obscure and unsatisfactory view of vegetable

the leaves. The pores are closed or contracted by the absence of heat, and the whole plant must be in a condition differing considerably from its state during the day.

201. From what has been said, it will be seen that we are still very much in the dark regarding the nature and uses of the action which takes place in the leaf, and the influence of external agents upon it. It is not unreasonable to suppose that the leaf is not regulated in its action entirely by the degree of light present. It must be borne in mind, that a plant is a being endowed with life, and capable, to a certain extent, of adapting the exercise of its functions to the circumstances in which it may be placed; and we may fairly presume, that the amount of carbon taken in by the leaf, or given out by this organ, will vary much according to the quantity in the sap derived from the soil, which, it is evident, must be very different in different situations *.

202. The sap, having in the leaf been rendered fit for the nutrition of the plant, descends in the innermost layer of the bark, being here called *proper juice*, assists in preparing the cambium, which acts such an important part in the formation of the new layers of wood and bark, and produces the different secretions which are found in the vegetable. Of these secretions, it is most probable that some are destined to renew the cambium along with the descending sap of the ensuing season, and some to qualify the ascending sap to promote the evolution and growth of the buds (105).

* For the fullest view of the state of this interesting question, I must refer to the works of Mr Ellis.

SECTION III.

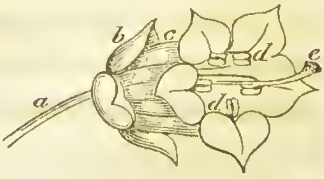
ANATOMY AND PHYSIOLOGY OF THE REPRODUCTIVE ORGANS.

203. The Reproductive Organs are those which serve for the continuation of the species. Every plant possesses some means of reproducing its kind: of these there is an infinite variety, from the simple homogeneous masses of cellular tissue which form the whole reproductive organs (sporules) of the lower tribes, up to the complex and elegant apparatus of flower and fruit which we observe in the higher orders, as in the Apple or Lily. They form the seed or rudiment of a new plant similar to that which produced it. At present we shall speak only of the reproductive organs of flowering plants.

CHAP. I.—THE FLOWER.

204. The Flower, taken in its widest sense, consists of the Bracteæ, the Peduncle, the Calyx, the Corolla, the Stamen, and the Pistil. The bracteæ and peduncle may be considered appendages. In the accompanying figure, *a* is the peduncle, *b* the calyx, *c* corolla, *d* the stamens, and *e* the pistil, in the Deadly Nightshade (*Atropa belladonna*).

Fig. 10.



205. Of these, the stamen (292) and the pistil (313) are the essential organs, as fructification in flowering plants can be carried on without the assistance of the others, of which more than one are occasionally wanting, but never without the co-operation of both these organs. Hence they in particular receive the name of *sexual organs.*

206. They generally exist together in the same flower, which in this case is called *hermaphrodite*, or *perfect.* When only one of them is present, the flower is termed *unisexual*, as in the Willow. The flower with the stamen is called the *male* or *barren* flower, because it fertilizes the pistil, and itself produces no seed: the one with the pistil is called the *female* or *fertile* flower, because it bears the fruit and seed.

207. When male and female flowers grow on the same plant, it is called *monœcious*, as in the Oak (*Quercus*). When the male and female flowers are on different plants, they are called *diœcious*, as in the Willow (*Salix*), the Hop (*Humulus*). When hermaphrodite, male, and female flowers are found irregularly set on the same plant, or on different plants, they are called *polygamous*, as in a species of Bed-straw (*Galium cruciatum*).

208. The calyx and corolla are envelopes which cover and protect the sexual organs, and probably perform some important function connected with air and light: the peduncle gives support to the envelope and the sexual organs, and connects them with the stem; and the bractea is an appendage which protects the flower in the bud, and in some cases supplies the place of the calyx.

209. The flower is considered by modern physiologists as composed of several whorls of metamorphosed leaves or bracteæ; the calyx being the lower or external whorl, the corolla the next, the stamens the next, and the pistil the inner or last whorl.

210. Plants of this kind are called *phenogamic*, or flowering, because they produce flowers; *sexual*, because they have sexual organs (205); *embryonate*, because they possess an embryo (403) or particular form of seed; *cotyledonous*, because the seeds are provided with cotyledons or seed-lobes (405); and *vascular*, because they contain spiral vessels (20). They receive these names to distinguish them from a class of plants which are destitute of spiral vessels, of cotyledons, of an embryo, of sexual organs, and of flowers (424).

I. THE PEDUNCLE.

211. When the flower is attached to the stem or branch by means of a stalk, this organ is called a *peduncle*; see *a*, fig. 10, par. 204. When there is no peduncle, the flower being attached by its base, it is said to be *sessile*, as in Common Star-thistle (*Centaurea calcitrapa*), and in Dodder (*Cuscuta*).

212. The peduncle is called a *scape* when it grows from the root, as in Primrose and Cowslip (*Primula vulgaris* and *P. veris*), Lily of the Valley (*Convallaria majalis*).

213. When the peduncle is branched, each of the divisions is called a *pedicel*; and the term *rachis* is applied to the main stalk from which the pedicels spring.

II. THE BRACTEA OR FLORAL LEAF AND ITS MODIFICATIONS.

214. Most flowers arise from the axilla of a leaf: this leaf, when different from the common leaves of the plant, is called a *bractea.* It sometimes resembles very much the other leaves of the plant, being smaller however, and closer to the flower; and at other times is very different from them both in colour and form, as in the Hydrangea, and in Purple Cow-wheat (*Melampyrum arvense*). In the Lime-tree (*Tilia europæa*), the peduncle arises from a lanceolate bractea. The leaves of the tree are broad, cordate, and serrated.

215. All leaves between the bractea and the calyx (249) are called *bracteolæ.*

216. An *involucre* consists of several bracteæ thickly set in a kind of whorl around the base of the flower, as in the Anemone, the Daisy (*Bellis*), and many others. The bracteæ are always called an involucre in the Umbel (237) and the Capitulum (245). The involucre is triphyllous, composed of three leaves, in the Anemone; tetraphyllous, pentaphyllous, &c. See Fig. 16, par. 239.

217. When there is round the pedicel (213) a whorl of floral leaves like a small involucre, they receive the name of *involucellum* or *partial involucre,* as in the Carrot (*Daucus carota*), which has an involucre of many leaves at the base of the peduncle, and a smaller one at the base of each pedicel. In this case the proper involucre receives the epithet of *general,* or *universal.* See Fig. 16, par. 239.

218. The *spatha* is a sheath completely enclosing the flowers before their expansion, and bursting longitudinally to make way for them, as in Snowdrop (*Galanthus nivalis*), Daffodil (*Narcissus*), Onion (*Allium*), and Wake Robin (*Arum maculatum*). In the latter example it encloses a spadix (243), and some restrict the term to this case. It is a sort of bractea or floral leaf, and Sir J. Smith gives it this name in the bulbous genera mentioned above. Many of the Palms have a spatha of a woody consistence. See Fig. 17, par. 243, the Wake Robin.

219. The *glume* or husk is something between a bractea and a calyx (249), and is found in Gramineæ and Cyperaceæ, which are destitute of a proper calyx. This term is most generally applied to the outer and thicker set of scaly leaves next to the sexual organs (205) in Grasses, two in number, and embracing each other at the base, Fig. 11, in which are seen the outer scales (glume or calyx), and the inner scales (corolla), with the awn attached. The stamens and pistils are removed.

Fig. 11.

220. Dr Hooker and Sir J. Smith consider the outer and inner coverings as calyx and corolla; and the former applies the term glume or valve to the individual pieces or leaves of each, (Hooker's Brit. Flora, p. 26.) Mr Brown applies the term glume to the outer covering, or calyx of Hooker, and considers the thin inner covering as the true perianth (247). These small thin leaves or scales are called *paleæ* by some (Lindley's Synopsis of the British Flora, p. 293). When these

scaly leaves enclose several flowers, they are with propriety called bracteæ. The term *scales* is applied to the minute bodies at the base of the ovary in the grasses (nectary of Linnæus and Smith, see par. 290).

221. According to Mr Lindley, the glume is to be distinguished from the calyx by its leaves being alternate and not verticillate. He considers all these scaly leaves as bracteæ. The bristly spiral appendage, called arista or awn, is attached to the inner covering.

III. THE INFLORESCENCE.

222. This term is used to express the manner in which the flowers are arranged on the plant.

223. The flowers are called *solitary*, when they grow separately at distant points of the stem, as Round-leaved Toadflax (*Linaria spuria*).

224. *Opposite the leaves,* when the flower is at the same height on the stem, and opposite to a leaf, as Narrow-leaved Water Parsnip (*Sium angustifolium*).

225. *Axillary*, when in the axilla of a leaf, as in the Ivy-leaved Speedwell (*Veronica hederifolia*).

226. *Extra axillary*, or lateral, when the flower grows from the side of the origin of a leaf, as in Common Garden Nightshade (*Solanum nigrum*).

227. *Epiphyllous*, when the flower grows on the surface of the leaf, as in Butcher's Broom (*Ruscus aculeatus*).

The flowers are said to be in the form of a

228. Spike (*spica*), when they are placed simply along a common stalk or axis, as in Plantain (*Plantago*), the genus Orchis, Wheat (*Triticum hybernum*), Great Mullein (*Verbascum thapsus*).

229. The term has also been applied to flowers in this form when the peduncle is very short, as Spiked Speedwell (*Veronica spicata*), which Dr Hooker calls a spicate raceme (233), Common Lavender (*Lavandula spicata*), Foxglove (*Digitalis*), &c.

230. The spike generally grows erect; and the expansion of its different flowers is progressive, the lower ones frequently having faded before the upper ones have opened.

231. The term *spikelet* (spicula) is applied to Grasses with many florets within one calyx (Smith), set on a little stalk, which is the spikelet, as in Meadow Grass (*Poa*), Ryegrass (*Lolium perenne*).

232. The spike is sometimes *unilateral* (secunda), the flowers all leaning to one side, as in Matgrass (*Nardus stricta*).

The Flowers are in the form of a

233. Raceme, or *cluster*, when they are numerous,

Fig. 12.

Fig. 13.

distant, peduncled, and arranged along a common stalk; differing from the spiked form only in having peduncles, and in being more distant, as Common Red Currant (*Ribes rubrum;* see Fig. 12.), Barberry (*Berberis vulgaris*).

234. The PANICLE resembles the raceme, but the peduncles are branched, longer, and more loose and distant, as in London Pride or None-so-pretty (*Saxifraga umbrosa*), Oats (*Avena sativa*), Fig. 13, and many Grasses.

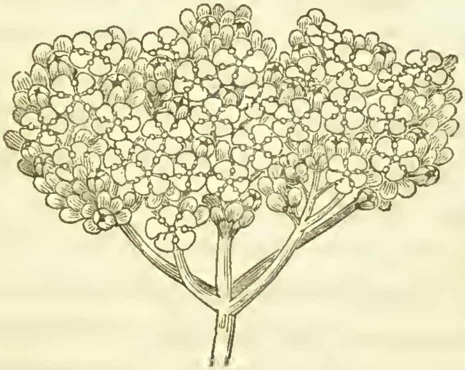
235. The CORYMB has the peduncles arising from different heights on the stem, but long in proportion to their distance from the summit, so that all the flowers are nearly at the same level, as in Common Yarrow (*Achillæa Millefolium*), Fig. 14, and many others of the order Compositæ.

Fig. 14.

236. The CYME has the peduncles arising from the same point, but irregularly divided into pedicels, which do not proceed from one central point, the flowers being nearly at the same level, as in the Elder (*Sambu-

cus nigra), Fig. 15, the Guelder-Rose (*Viburnum*), and the Wild Cornel or Dogwood (*Cornus sanguinea*).

Fig. 15.



237. The UMBEL has all the peduncles nearly equal to each other, springing from the same point, diverging like rays, the flowers in a globular or semi-spherical form, and the pedicels arising regularly from a central point: Fig. 16, Mountain Stone Parsley.

238. The umbel is *simple*, when each peduncle is single flowered, as in Broad-leaved Garlic (*Allium ursinum*), Cowslip (*Primula veris*). When the flowers of a simple umbel rise nearly to the same level, Richard calls it a *sertulum*.

239. The umbel is *compound*, when each peduncle at one point divides into many nearly equal pedicels, which bear the flowers. This is the case in the Carrot (*Daucus Carota*), Parsnip (*Pastinaca sativa*), Hemlock (*Conium maculatum*), and the rest of the Umbelliferæ.

Fig. 16.

240. The peduncles, taken together, form the umbel: the pedicels at the extremity of each peduncle form what is called a *partial umbel.*

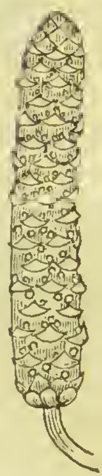
241. The THYRSUS is a panicle in which the peduncles are irregularly divided, but sometimes have an umbellate form, and the middle branches of which are longer than those at the base or summit, as the Lilac (*Syringa vulgaris*), the Vine (*Vitis vinifera*). Some consider the vine as a raceme.

242. The WHORL (*verticillus*) is that form of inflorescence in which the flowers are arranged in a ring round the stem, as in Common Mare's-tail (*Hippuris vulgaris*), White Dead-nettle (*Lamium album*), Pennyroyal (*Mentha pulegium*), and many of the Labiatæ.

243. The SPADIX is a spike in which the flowers are set very close, and enclosed in a spatha, as Wake Robin (*Arum maculatum*), Fig. 17. It is found only in monocotyledonous plants; in those which are naked (248) and unisexual (206), as in the Aroideæ.

Fig. 17.

Fig. 18.



244. The CATKIN (*amentum*) consists of a cylindrical receptacle (291), with closely imbricated scales or bracteæ covering unisexual flowers, as in the Walnut (*Juglans regia*), the Fir (*Pinus*), the Birch (*Betula*), and the rest of the Amentaceæ, *Juss.* The fir-top is a catkin. The catkin of the Hop (*Humulus lupulus*) contains the bitter principle which renders this plant so valuable in brewing. See Fig. 18, the catkin of the Hazel (*Corylus Avellana*).

245. The CAPITULUM, head, or tuft, has the flowers sessile, or with very short peduncles, and ranged in a globular form, as in Common Thrift or Sea Gilly-flower (*Statice Armeria*), Trefoil (*Trifolium*), Scabious (*Scabiosa*). This is an umbel with nearly sessile flowers, and the term has been applied also to compound flowers (340), as the Thistles, in which the receptacle or top of the peduncle swells out into a spherical shaped body, called *phoranthus* (291), which supports the flowers. The capitulum is found in the Dipsaceæ, Compositæ, Calycereæ, &c.

IV. THE FLORAL ENVELOPE.

246. This consists of one or two whorls of leaves of a peculiar form and appearance, immediately surrounding the sexual organs (205). When there are two whorls, the inner, that nearest to the stamens and pistil, is called *corolla*, the outer is called *calyx*, and the plant is called *dichlamydeous*. When there is only one whorl, it receives the name of *calyx*, whatever be its form or appearance; and the plant is called *monochlamydeous*.

247. Considered as a whole, the floral envelope, whether there be one whorl or two present, receives the name of *perianth* (perianthium *or* perigonium). The perianth is called *simple,* when it consists of the calyx alone; *double,* when both calyx and corolla are present.

248. When neither calyx nor corolla is present, the plant is called *achlamydeous,* and the sexual organs are said to be *naked,* as in Wake Robin (*Arum*).

V. THE CALYX.

249. This organ consists of a whorl of leaves placed at the top of the peduncle, immediately below the sexual organs, when there is no corolla; and when the latter is present, immediately below it. It is called *flower-cup,* from embracing the lower part of the corolla, which appears to rest in it; see *b,* Fig. 10, par. 204.

250. When the corolla is present, the calyx is generally shorter than it, and of a green colour. When there is no corolla, the calyx (246) is generally thick, large, and richly coloured, having much of the appearance of the corolla, as in the Tulip and the Lily, the coloured flowers of which are considered as a calyx, or as a calyx or corolla united. In many monocotyledonous plants the calyx is the sole floral envelope.

251. The separate parts or divisions of which the calyx consists are called *sepals.* When these are united by their margins, so as to form one piece of a more or less tubular form, the calyx is called *monosepalous,* or *monophyllous,* as in Henbane (*Hyoscyamus*) and the other Solaneæ, and in the Labiatæ. The lower part,

where the sepals are united, form what is called the *tube*. They are generally spread out, and remain separate above, and there constitute the *limb*. See Fig. 19.

252. The monosepalous calyx has different terms applied to it, according to the mode in which the limb is divided. It is

253. *Toothed* (dentatus), when the divisions are very short, and have the appearance of sharp teeth.

254. *Cleft* (fissus), when the divisions extend about half way down: bifid, trifid, &c.; see Fig. 20, par. 269.

255. *Partite* (divided), when the divisions are very deep.

With respect to form, the monosepalous calyx is

256. *Tubular;* when it is cylindrical, long, and narrow, as in Cowslip (*Primula veris*); see Fig. 19.

257. *Ventricose* (urceolate); the tube swelled, but becoming narrow near the limb, like a pitcher.

258. *Inflated;* thin, and dilated like a bladder, as in Bladder Campion (*Silene inflata*).

259. *Campanulate;* shaped like a bell.

260. *Two-lipped* (bilabiate); having its limb so divided as to represent an under and upper lip, as in Sage (*Salvia*), and many of the Labiatæ.

261. When the sepals are separate and distinct from each other from the base, the calyx is *polysepalous* or *polyphyllous*, as in Wall-flower (*Cheiranthus Cheiri*). See Fig. 22, par. 278.

262. The calyx is called *superior* when it adheres to the ovary (313), in which case it is necessarily monosepalous, as every point in the circumference of the

ovary is in contact with a part of the calyx; and the ovary is called *adherent* or *inferior*. When there is no adhesion, the calyx is *inferior*, or inserted below the ovary, which is called *free* or *superior*. The terms "superior" and "inferior," as applied to the various parts of the flower, are explained in par. 302, 304, 331, and 332.

VI. THE COROLLA.

263. This is the inner whorl of leaves, when the perianth is double, placed immediately next the sexual organs, of a delicate texture, and generally highly coloured, forming the chief beauty of the flower. See *c*, Fig. 10, par. 204. It exists only when the perianth is double, the single envelope always receiving the name of calyx. In some cases there is a little difficulty in finding if the perianth be double or single, as in some monocotyledons, where the floral envelope consists of six petaloid leaves, in which an outer and inner whorl can scarcely be distinguished. In such cases, however, some botanists speak of calyx and corolla, considering as calyx the three leaves which appear the more external.

264. The individual parts or divisions of which the corolla consists are called *petals*. When these are united by their margins, so as to form one leaf, or petal, of a more or less tubular form, the corolla is called *monopetalous*, as in Primrose (*Primula*), Foxglove (*Digitalis*), &c. See Figures 19 and 20, page 81.

265. The cylindrical part of a monopetalous corolla is called the *tube*: the upper spreading part is called

or *unguiculate*, as in the above examples. Ranunculaceæ, Rosaceæ, and Cruciferæ are examples of the polypetalous corolla.

277. The petals are sometimes *erect*, as in the Water Avens (*Geum rivale*); *inflexed*, the point curved inwards, or towards the centre of the flower, as in Carrot, Angelica, and many of the Umbelliferæ; *reflexed*, the point turned outwards.

The polypetalous corolla is regular or irregular. The regular polypetalous corolla is

278. *Cruciform*, when there are four clawed petals arranged in the form of a cross, as in Wall-flower (*Cheiranthus Cheiri*), Turnip (*Brassica*), and all the plants in the natural order Cruciferæ: Fig. 22, the flower of Charlock.

Fig. 22.

Fig. 23.

279. *Rosaceous*, when there are five petals, with little or no claw, spreading out like a rose, as in the Rose, the Bramble (*Rubus*), Cinquefoil (*Potentilla*), the natural order Rosaceæ. See Fig. 23, the flower of *Pyrus malus* (Crab-apple).

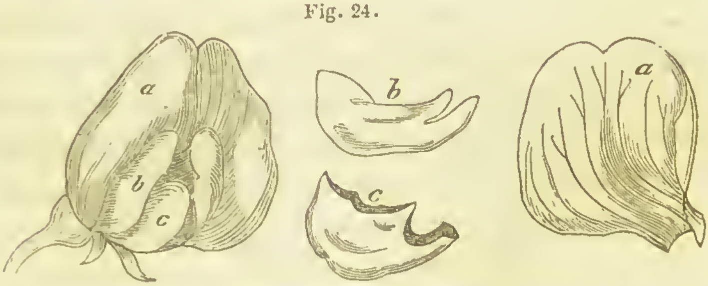
280. *Caryophyllaceous*, when the five petals are deep-

ly clawed, as in Catchfly (*Silene*), Pink (*Dianthus*), Corn-cockle (*Agrostemma Githago*), and the Caryophylleæ.

The irregular polypetalous corolla is

281. *Papilionaceous*, when there are five petals, of which the uppermost and posterior is broad and dilated; the two middle and lateral ones are parallel to each other; and the two lower are also parallel and connected by their anterior or lower margins. The first is the *vexillum*, or *standard:* the next two are the *alæ*, or *wings:* and the other two form the *carina*, or *keel*. This kind of corolla is found in the Pea and Bean, and the rest of the Leguminosæ. It is called papilionaceous from having a resemblance to a butterfly with expanded wings. See Fig. 24, in which *a* is the vexillum, *b* the ala (of which there are two), and *c* the carina, or keel.

Fig. 24.



282. The other forms of irregular polypetalous corolla, as in the Monk's-hood (*Aconitum*), Larkspur (*Delphinium*), Violet, &c., are incapable of being reduced to any order.

283. The petals generally alternate with the sepals, that is, each petal is opposite to the space between the two sepals, not to a sepal. This is well seen in the Cruciferæ. See Fig. 22, par. 278.

the *limb.* These parts are well seen in the Cowslip, Fig. 19, par. 268.

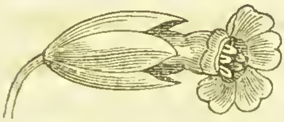
The monopetalous corolla is regular or irregular.

266. It is *regular* when its figure is uniform, its incisions being equal, and the parts regularly disposed round an imaginary axis, as in the Cowslip, and in Nightshade ; see Fig. 10, par. 204.

The monopetalous regular corolla is

267. *Bell-shaped* (campanulate), as in the Bell-flower (*Campanula*), Bindweed (*Convolvulus*), Jalap (*Convolvulus jalapa*), and many others. See Fig. 10, par. 204.

Fig. 19.



268. *Tubular*, when the tube is long and cylindrical, as in Lilach (*Syringa vulgaris*), or cowslip, Fig. 19.

Fig. 20.

269. *Funnel-shaped* (infundibuliformis), when the tube, being narrow at the lower part, gradually widens towards the limb, as in Lungwort (*Pulmonaria*), Tobacco (*Nicotiana tabacum*), Fig. 20.

270. *Salver-shaped* (hypocrateriformis), when the tube is long and narrow, and diverges abruptly into a horizontal spreading limb, as in Primrose, in Cowslip, Fig. 19, Lilac, &c.

271. *Rotate*, or wheel-shaped, like the last, but with a very short tube, as Borage (*Borago*), Nightshade (*Solanum*).

272. *Ventricose*, or urceolate, pitcher-shaped, con-

tracted at the orifice, as in Heath (*Erica*), sometimes called campanulate.

273. The monopetalous corolla is irregular, when the incisions are not uniform, or the opposite sides are irregularly placed round an imaginary axis, as in Toadflax (*Linaria*), Snapdragon (*Antirrhinum*). See Fig. 21, the corolla of Ground-ivy (*Glechoma hederacea.*)

Fig. 21.

The monopetalous irregular corolla is

274. *Ringent, labiate*, or *bilabiate*;—gaping, like the mouth of an animal, the tube widening at the upper part, and the limb being divided transversely into two unequal parts; one, called the upper, sometimes longer than the other, or lower one; as in Sage (*Salvia*), Dead-nettle (*Lamium*), Ground-ivy (*Glechoma*), Fig. 21, and all the Labiatæ. In some, the lips are nearly equal in length, as in Thyme, Bugle (*Ajuga*), Marjoram (*Origanum*), &c.

275. *Personate*, when the tube is expanded, and the orifice narrowed by the approximation of the two lips, which are unequal, as Toadflax (*Linaria*), Snapdragon (*Antirrhinum*). The corolla of the Foxglove is sometimes called personate, sometimes campanulate unequal.

276. When the petals are separate and distinct from each other from the base, the corolla is *polypetalous*, as in *Raphanus Raphanistrum* (Wild Radish or Jointed Charlock), Fig. 22, par. 278; the Pink (*Dianthus*). The lower part is called the *unguis* or *claw*; the upper spreading part the *lamina* or *border*. When the claw is large and well marked, the petal is said to be *clawed*

anther. It is called *prominent*, when it projects beyond the anther; *petaloid*, when it is broad and thin, like a petal.

294. The *anther* is the essential part, as it contains the *pollen* (296), or fecundating powder. It is of a cellular texture, and generally consists of two cells, or membranous bags, sometimes called *lobes*, the sides of which are called *valves*. These are generally united by means of a transverse body called *connectivum*.

295. The part at which the anther opens to emit the pollen, is called the point of *dehiscence*. This generally takes place along a line or suture, running along a groove on the surface of each cell; and the anther is then said to be longitudinally dehiscent, as in the Rosaceæ. When the opening takes place only at parts of this line, or at other parts of the anther, the anther dehisces by pores, as in the Ericineæ, Solanum, &c.

296. The *pollen* is a fine powder, consisting of small bags or vesicles, containing a mucous fluid. The function of the pollen is to impregnate the ovules (333); and for this purpose it is scattered on the stigma (316), on which the bags burst and emit their fluid, which is then conveyed to the ovules.

297. The number of stamens in different plants is very various. Flowers with one stamen are called *monandrous*; with two, *diandrous*, and so on.

298. When there are four, of which two are longer than the other two, they are called *didynamous*, as in the most of the Scrophularineæ and Labiatæ. When there are six, of which four are longer than the other two, they are called *tetradynamous*, as in Wall-flower, and the rest of the Cruciferæ. See Fig. 23, page 83.

299. When they are united by their filaments, they are called *monadelphous* (Fig. 26.) if they form a tube, as in Mallow (*Malva*); *diadelphous* (Fig. 27.), as in the Pea, and the rest of the Leguminosæ; *triadelphous*, *po-*

Fig. 26.

Fig. 27.

lyadelphous, according to the number of separate bundles or fasciculi into which they are formed. In Fig. 27, *a* is the pistil (313); the other bodies are stamens, nine united, and one free, or diadelphous.

300. When the stamens are united by their anthers, they are called *syngenesious*, as in the Daisy, the Thistle, &c. This is the distinguishing character of the extensive natural order Compositæ.

301. When they are incorporated with the pistil (313), they are called *gynandrous*, as in Orchis, and the rest of the Orchideæ.

302. The stamens are *hypogynous* or *inferior*, when they, or the monopetalous corolla on which they are placed, are inserted *under* the ovary, or pistil: as Poppy (*Papaver*), Crowfoot (*Ranunculus*), the Cruciferæ. See Frontispiece, Fig. 5, the Common Red Poppy, in which the stamens are seen to be inserted at the base of the central body—the pistil, or ovary (313).

VII. THE ÆSTIVATION.

284. The various parts of the flower are folded in different ways in the bud, and in this state afford excellent characters for the distinction of natural orders. The arrangement of the parts has received the name of *æstivation*, or *prefloration*.

The æstivation is

285. *Imbricate*, when each petal covers a small portion of the adjoining one, as in many of the Umbelliferæ.

286. *Valvate*, when the petals touch each other only by their margins, as in the Araliaceæ.

287. *Folded* (plicata), or plaited, when a monopetalous corolla is regularly folded, as in the Convolvulaceæ, and many of the Solaneæ.

288. *Corrugate*, when the petals are irregularly folded and wrinkled or crumpled, as in the Cisteæ.

289. *Contorted*, or twisted, as in the Apocyneæ.

VIII. THE NECTARY.

290. This is a part of the calyx or corolla, and the term was applied by Linnæus to any irregular part attached to either of these organs, as in the Columbine (*Aquilegia*), the five petals of which terminate inferiorly in a sort of spur, which is the nectary. In the Violet, the lower petal is spurred at the base, or has a nectary: in the Crowfoot (*Ranunculus*), each petal has a small square body, or nectary, at the base. The term is applied to the elongation of the calyx in the Indian Cress (*Tropæolum majus*); to the glands found at the

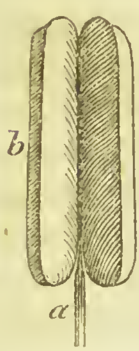
base of the stamens in the Cruciferæ; and to the two petal-like bodies or long stalks concealed within the helmet-shaped leaflet of the Monk's-hood (*Aconitum*). It has been supposed that it secretes and contains the honey. The calyx or corolla is called *spurred* (calcarata), when there is a spur or nectary, or prolongation of the base.

IX. THE RECEPTACLE.

291. This is the extremity of the peduncle or pedicel, and to it the calyx, corolla, and stamens are generally fixed. It is also called *torus.* It is very prominent in the Compositæ, as the Thistle (*Carduus*), the Daisy (*Bellis*), and in them is called *phoranthus* by Richard. It is conical in the Daisy, hairy in the Thistle, chaffy in Burdock (*Arctium*). In the *Ranunculus* or Crowfoot, and in the Poppy, the pistils rest upon this organ, and the stamens, calyx, and corolla are inserted into it. The part of the Strawberry which is eaten is the enlarged receptacle.

X. THE STAMENS.

Fig 25.



292. These are next to the perianth, being enclosed by it, and each consists of two parts, the filament and the anther; the former supporting the latter, which is the essential part. In Fig. 25, *a* is the filament, and *b* the anther of the Crocus

293. The *filament* is the long slender body forming the lower part of the stamen, and swelling out superiorly into the

Fig. 28.

303. The stamens are *perigynous*, or around the ovary, when they are inserted into the calyx, as in the Rose, and other Rosaceæ. See Fig. 28, the flower of the Dog-rose, the petals being removed.

304. The stamens are *epigynous*, or *superior*, when they are inserted *above* the ovary, or when united both with the calyx and ovary, as in the Umbelliferæ. See Frontispiece, Fig. 6.

305. The terms " inferior " and " superior " are often applied to the perianth, indicating the same situation in that organ, as when applied to the stamens. The situation of the stamens is a point of great importance in a natural arrangement of plants.

306. In general the stamens correspond with, or are opposite to, the sepals, being alternate with the petals, or opposite to the spaces between them; and they are frequently of the same number as the petals, or some multiple of that number.

307. The stamens are frequently changed into petals, and are considered as modified petals (209); the filament being analogous to the *claw* (276), the anther to the *lamina* (276). And as the petal is considered as a modified leaf, the stamen must necessarily be also a modified leaf, the filament representing the *petiole* (136), and the anther the *lamina* or *disk* of the leaf (136).

XI. THE DISK.

308. This term is applied to the fleshy part that occasionally intervenes between the stamens and the pis-

til, and is often an expansion of the receptacle (291). It is

309. *Hypogynous*, when it is between the receptacle and the ovary, which is in this case superior (331), Cruciferæ, Labiatæ.

310. *Perigynous*, when it lines the tube of the calyx; Rosaceæ, Pomaceæ.

311. *Epigynous*, when it is placed above the ovary, which is inferior (332); Umbelliferæ.

312. The insertion of the stamens and position of the disk always correspond. The disk is always found in the Rosaceæ, Labiatæ, Umbelliferæ, Boragineæ. In Peony, it is in the form of a shallow cup, surrounding the base of the ovary.

XII. THE PISTIL.

313. This organ stands in the centre of the flower, and appears to be a continuation of the peduncle. It consists of three parts; the *ovary* or *germen*, the *style*, and the *stigma*. In general, there is only one pistil, as in the Poppy. Sometimes, however, there are many, as in the Ranunculus. See Fig. 29. (*Atropa Belladonna*), in which *a* is the ovary or germen, *b* the style, and *c* the stigma.

Fig. 29.

314. The *ovary* is the lower and thicker part, containing the ovules (333). It consists of one cell or more, each of which may be considered a distinct ovary.

315. The *style* is the long cylindrical body placed upon the ovary, and terminates superiorly in the stig-

ma, which it supports. The style is not essential, being frequently absent. It is generally continuous with the apex of the ovary. In some cases, it arises from the side of this organ, being then called *lateral:* as in Lady's-mantle (*Alchemilla vulgaris*).

316. The *stigma* is of a glandular nature, being generally covered with a viscid fluid; and is essential, as it receives and exerts a peculiar action on the fecundating pollen (296). It is called sessile, when the style is absent, being then placed immediately above the top of the ovary; Poppy (*Papaver*). See Frontispiece, Fig. 5.

317. The pistil is frequently attached to the receptacle by a prolongation of the substance of the latter, called a *thecaphore* or *gynophore*. In the Strawberry (*Fragaria vesca*), the fleshy part which is eaten is the *gynophore*, the little whitish bodies being the pistils matured.

318. The observations of modern physiologists, particularly of M. De Candolle and Mr Brown, have led them to consider the pistil as the modification of a leaf, or of a whorl of leaves, growing vertically. To a leaf, in this modified state, they have given the name of *carpel* (carpellum).

319. They describe a carpel as being formed of a folded leaf, of which the upper surface is turned inwards, the under surface outwards, and the margins are united, thus forming a hollow case or ovary.

320. The margins produce interiorly one or more buds (155), which are the ovules (333). The regular mode of production is a vertical row of buds on each margin.

321. The gynophore (317) is deemed a modification of the stalk of the leaf or leaves which form the pistil; the style an elongation of the midrib; and the stigma the apex of the midrib endowed with a secreting property.

322. In many flowers, the styles and stigmas remain separate, while the ovaries are closely united; and sometimes the reverse takes place. Originally, however, each carpel has a separate style and stigma.

323. The *ovary* is considered as formed of the lamina or disc of the leaf which became the carpel, and is a hollow body, containing the ovules or rudiments of the seeds. Its cavities are called cells. When there is only one cell in the ovary, it has been formed of a single carpel or modified leaf; or by the obliteration of the dissepiments (324), as in Poppy.

324. In the many-celled ovary, each cell is formed of a single carpel, and the partitions between the cells are composed of the contiguous sides of the carpels. The partitions are called *dissepiments*. They are vertical, formed of two layers, and equal in number to the carpels of which the ovary is formed.

325. The ovary is *unilocular*, *bilocular*, &c., according to the number of cells.

326. Where the margins of the folded leaf or carpel unite, there is interiorly a thickening of cellular tissue, forming what is called the *placenta* or *trophosperm*. It is this body that bears the ovules.

327. The carpels, like leaves on a branch, are developed round a central axis, towards which all their margins are turned; and the placentæ, being formed at the margins of the leaves, are almost always next

this imaginary central line or axis, running down interiorly on the edges of the carpels. And hence the dissepiments appear to run backwards or outwards from the placentæ.

328. The placentæ are *central*, when in the situation described in the last paragraph, the dissepiments being entire.

329. A *free central* placenta is formed when the dissepiments in a many-celled ovary shrink backwards, or become obliterated, and the placentæ remain united in the centre of the ovary.

330. The placentæ are *parietal*, when, owing to the contraction of the dissepiments, which do not divide the ovary into several distinct cells, but merely project from its inner surface, they are placed near its walls, on the free edges of the dissepiments, as in Poppy.

331. When the ovary is free in the flower, that is, forms no adhesion to the sides of the calyx, its base and that of the stamens being inserted into the top of the receptacle, it is called *superior;* and they are *inferior*, or *hypogynous;* as in Tulip, Poppy, Crowfoot (*Ranunculus*). See Frontispiece, Fig. 5. the Poppy, in which the stamens and corolla are seen inserted into the receptacle, below the pistil.

332. When the ovary adheres to the sides of the calyx, and the stamens and corolla are inserted into the latter, or when they are inserted into a disk above the ovary, this organ is called *inferior*, and the perianth and stamens are *epigynous* or *superior;* as in Umbelliferæ, Valerianæ, Dipsaceæ, &c. See Frontispiece, Fig. 6. the flower of Snowdrop (*Galanthus nivalis*), in which

the stamens and perianth (247, 304) are seen inserted on the top of the ovary.

THE OVULE.

333. This is the seed in its unimpregnated state. It is found in the ovary (313), adhering to the placenta or trophosperm (326), and is considered as the bud of the carpel or modified leaf (320). It is generally attached to the placenta by a little stalk called *funiculus* or *podosperm*. See Fig. 30, par. 374, in which is seen the funiculus of the matured ovule or seed of the pea. Its base is that part which is connected to the podosperm, and is called *umbilicus* or *hilum* (397). The opposite extremity is the apex.

334. When the placenta (326) is developed only at the upper part of the margin of the carpel, the ovules necessarily hang down into the cell or cavity of the carpel, and are called *pendulous* or *reversed*. When the placenta is developed only at the lower part of the margin, the ovules are *erect*, projecting upwards into the cavity.

335. Some botanists use also the terms *suspended* and *ascending* to express these two positions of the ovule; while others limit these terms to those cases in which the placenta is developed along the whole margin of the carpel, the direction of the ovule still remaining the same.

336. The ovule consists of a *nucleus* or *kernel* (the essential part, and the basis of the future seed), enclosed within two sacs, which are called *primine* and

secundine. These are frequently connected to each other and to the nucleus at the base (333) of the ovule, which is the regular position of the parts.

337. It sometimes happens that the base of the nucleus, or point of connection between it and the sacs, is at the apex (333) of the ovule, the position being altered during the growth of the latter. In this case a bundle of vessels, called a *raphe*, extends between the base of the ovule and the base of the nucleus, to supply the latter with nourishment. The raphe enlarges where it joins the base of the nucleus, forming the *chalaza.*

338. The primine and secundine have open mouths, which are applied to each other and to the apex of the nucleus, forming a foramen called *exostome* or *micropyle,* through which the impregnating particles of the pollen pass to vivify the nucleus. The radicle of the seed (414) is always next to this foramen.

339. The nucleus contains the *liquor amnios* which affords nourishment to the young embryo, and part of which assists to form the albumen (400); and some recent authors have described it as being covered by three coats, the *tercine, quartine,* and *quintine;* of which the first two become the albumen in the seed, and the last becomes the organ occasionally present, called *vitellus* (404). The nucleus with its coverings becomes the seed with its coats, to form which is the ultimate object of the whole apparatus of the reproductive organs.

CHAP. II.—COMPOUND FLOWERS.

340. There is a class of flowers which in many points differ so much from the generality of flowers, that they require to be separately noticed. They are called *compound*, because what appears to be one flower consists of a great number of florets or little flowers, sessile on one receptacle (291) called phoranthus, and occasionally very different from each other in form and other respects.

341. The most marked character of this class of flowers is the union of the stamens by the anthers, which has procured for them the epithet *syngenesious*. The Daisy (*Bellis*), the Dandelion (*Leontodon Taraxacum*), the Thistle (*Carduus*), the Dahlia, the China Aster (*Aster Chinensis*), the Artichoke (*Cynara Scolymus*), and the Sunflower (*Helianthus*), are examples of this class.

342. The florets are monopetalous (264), very small, and, in many, of two kinds; those of the *disc*, which are in the centre, and those of the *ray*, which are in the circumference, the external ones which enclose the preceding.

343. Those of the disc are *tubular*, and five-cleft; and are yellow in the Daisy. Those of the ray are called *ligulate*, or strap-shaped, and are expanded into a long, narrow, ribbon-shaped leaf. They are white in the Daisy.

344. The calyx is closely adherent to the ovary, and is not very distinct. The stamens are five in number, and united by their anthers into a cylinder, through

which the extremity of the style passes; and many of the florets are unisexual (206).

345. When the flower or head is composed solely of tubular florets (343), it is called *flosculous*, as the Artichoke and Thistle.

346. When all the florets are ligulate (343), the flower is ligulate or *semiflosculous*, as Lettuce (*Lactuca*), Dandelion.

347. When the central florets are tubular, and those of the circumference ligulate, the flower is *radiate*, as the Daisy, the China Aster.

348. The calyx in most compound flowers terminates in little hairs, which remain and are elongated after the corolla has fallen, forming the pappus or seed down (349), which acts the part of wings, and assists the seed to fly away from the receptacle. The calyx surrounds the ovary, and becomes the most external covering of the seed.

349. The pappus is *sessile* when situated immediately on the top of the seed; *stipitate*, when supported on a little stalk called *stipes*, as in Lettuce; *simple*, when hairy and undivided, as in Lettuce; *feathery*, when small fine hairs project from the sides of the larger hairs like a feather, as in Goat's-beard (*Tragopogon*).

CHAP. III.—FECUNDATION.

350. This operation consists in the action of the pollen on the ovule, which is thereby *impregnated*, that is, excited to a new and vigorous mode of action, by which it increases in size, all its parts are fully de-

veloped, and at last it becomes a *seed* (396), capable, when placed in a situation favourable to its growth or germination, of producing a full grown plant similar to that which gave it birth.

351. To effect this, it is necessary that the pollen contained in the anther of the stamen be allowed to escape, which takes place by the dehiscence (295) of the anther; and that this pollen be brought into contact with the stigma, the moist surface of which causes the bags or vesicles (296) to burst, and emit the vivifying mucous fluid, which is then conveyed along the style to the *micropyle* (338), which admits it to the nucleus or kernel (339), there to produce its peculiar effects.

352. The pollen is conveyed to the stigma in various ways. In many hermaphrodite plants (206), the stamens are longer than the pistil; and the pollen, when it escapes from the anther, naturally falls on the stigma. In such cases, as Linnæus remarked, the flower is generally erect. When the stamens are shorter than the pistil, the flower frequently hangs downwards or droops, thus still enabling the pollen to fall on the stigma when it escapes. When the stamens are short, and the flower erect, there is frequently a nectary at the bottom of it, which attracts insects in search of honey; these become covered with pollen, which falls from them on the stigma as they fly out. The stamens of many plants are endowed with a certain degree of irritability, by which they are enabled to bend towards the stigma and deposit their pollen, returning afterwards to their usual position.

353. In monœcious (207) plants, the male flowers are frequently situated on the upper part, so that the

pollen falls on the stigma. In these, and in diœcious (207) plants, the wind is perhaps the chief agent in conveying the pollen, which is a light powder, from the male to the female flowers; and butterflies and other insects which fly from flower to flower also carry and deposit the pollen. In Persia, the female or fertile Palms chiefly are cultivated, and at the flowering season branches of Wild Palms with male flowers are gathered and shaken over the fertile flowers. This was practised long before the theory of the operation was known.

354. When fecundation has been effected, the stamens and floral envelope, and also the style and stigma, are of no further use. They generally wither and fall off, though occasionally one or more are persistent. The calyx frequently forms a covering for the ovary, as in those cases where the ovary is inferior, as in the Apple; the stigma frequently remains, as in the Poppy. The ovary, of course, constantly remains, and forms the future pericarp or covering of the seed (356), while the ovule becomes the seed.

CHAP. IV.—THE FRUIT.

355. The fruit is composed of the ovary and its contents, arrived at maturity by the fecundating influence of the pollen; and consists of two parts, the *pericarp* or covering, which is the ovary matured, and the *seed*, which is the ovule matured. When the ovary is inferior (332), the external part of the pericarp is formed of the tube of the calyx.

I. THE PERICARP.

356. This organ is almost invariably present, but sometimes remarkably thin, as in the Umbelliferæ and Compositæ; and in the Coniferæ and Cycadeæ is said to be altogether wanting.

357. The part by which it is attached to the peduncle is called the *base*. The other extremity is the *apex*, and frequently exhibits traces of the style or stigma. The *axis* is an imaginary line passing from the base to the apex. When there is a real axis it is called *columella*, as in the Euphorbiaceæ and the Umbelliferæ. There is a very distinct columella in the Orange.

358. It consists of three parts; the *epicarp*, a thin membranous outer coating; the *endocarp* or *putamen*, the inner membrane which lines the cavity containing the seed; and the *sarcocarp* or *mesocarp*, a fleshy or pulpy substance lying between these thin membranes. The fleshy or juicy part in Apples, Pears, Peaches, &c. is the sarcocarp. The rind or paring in these fruits is the epicarp. In the Apple, the endocarp is seen very distinctly lining the cells which contain the seeds.

359. In the nut these three parts are closely united. In the Pea, the pod of which is the pericarp, the sarcocarp is thin but evident, and the epicarp and endocarp are also distinct.

360. A pericarp consisting of one cell is called unilocular, as the Cherry (*Cerasus*), the Almond (*Amygdalus*), the Pink (*Dianthus*). When there are two cells it is *bilocular*, as in Foxglove and the rest of the Scrophularineæ. It is trilocular, &c. according to the number of the cells.

361. The cells are separated by partitions called dissepiments, which, from their mode of formation (324–7), will always be alternate with the stigmas, the latter being the apices of the carpels, while the dissepiments are their sides. In the mature state, the dissepiments may be considered as formed of two layers of endocarp adhering closely to each other.

362. In consequence of various accidental occurrences, such as the abortion or obliteration of particular parts, or the irregular growth of others, particularly of the placenta (326), the pericarp does not always present the same structure as the unimpregnated ovary. In the Oak (*Quercus*), and other Cupuliferæ, the ovaries of which have several cells and ovules, the fruit has only one cell, and frequently only one seed.

363. The dissepiments of a many-celled pericarp often become contracted, so as merely to project into the general cavity, the placentæ being placed upon their edges and called *parietal*, as in Poppy. Or it may be supposed that the margins of each carpel have not united, and do not reach to the centre or axis of the pericarp, the placenta being then placed upon the united margins of the adjacent sides of two carpels. In the Melon, the carpels are scarcely folded inwards, and the cells are not separate. In the Thorn Apple (*Datura Stramonium*), two of the dissepiments are imperfect at the upper part, forming a communication between the cells, which are quite separate inferiorly. The dissepiments in these cases are called *incomplete*. Spurious or false dissepiments are those formed by enlargements of the placenta, or irregular projections from the back or

sides of the pericarp (*Cassia fistula*): when horizontal they are sometimes called *phragmata.*

364. When the pericarp does not open spontaneously when ripe to let the seed escape, it is called *indehiscent.* When there are natural slits or openings by which the seed can escape, the pericarp is said to be *dehiscent,* and the pieces into which it divides are called *valves.* It is bivalved, trivalved, &c. according to the number of valves into which it splits.

365. Pericarps which are formed of a single carpel or modified leaf, have on their surface two well marked lines or sutures, by which they easily dehisce. One is called *dorsal,* and occupies the place of the midrib of the leaf which became the carpel. The other is called *ventral,* and corresponds to the united margins of the leaf where the placenta is situated. The pod of the Pea has a dorsal and ventral suture, both well marked. In shelling peas it is the dorsal suture by which they are opened, and the peas or seeds will be observed placed on a thin placenta at the opposite or ventral suture. In the many-celled pericarp, each cell or carpel has a more or less distinct dorsal and ventral suture, by which the dehiscence often takes place, as in Foxglove.

366. The dehiscence is *loculicidal* (splitting or breaking into the cells), when the pericarp bursts vertically at the back of the cells or by the dorsal suture, the layers forming the dissepiments being left in union, and the valves being opposite to the dissepiments, (each valve in this case consisting of the adjacent halves of two adjoining carpels): the Liliaceæ.

367. The dehiscence is *septicidal* (splitting the dis-

sepiments), when the pericarp bursts vertically in a line corresponding with the union of the sides of the carpels, the layers forming the dissepiments being separated from each other, the valves being alternate with the dissepiments, and having their margins turned inwards, and the cells remaining closed at the dorsal suture. Rhodoraceæ Juss.

368. The dehiscence is *transverse*, when it takes place horizontally along the cells of the pericarp, as in the capsule (380) of Pimpernel (*Anagallis*). The capsule is in this case called *circumscissa*.

369. The pericarp dehisces *by pores*, when there are several irregular holes or openings, as in the Poppy, in the capsule of which the pores are placed beneath the permanent stigma.

370. When the pericarp has lateral appendages like wings, it is *dipterous*, *tripterous*, &c. according to the number of these; it is *apterous* when there are none.

VARIETIES OF PERICARPS OR FRUITS.

371. There are many different kinds of pericarps or fruits. Some are *simple*, being the result of a single carpel, of course in one flower, as the Pea; others are *compound*, being composed of several carpels united into one pistil, of course in one flower, as the Apple: some are *multiple*, consisting of several carpels in one flower, but remaining distinct in the matured state, as the Strawberry; and others are *aggregate*, consisting of the fruits of several flowers united into one mass, as in the Pine-Apple (*Bromelia ananas*).

372. Some fruits are *dehiscent* (364), as the Fox-

glove and Poppy; others are *indehiscent* (364), as the Peach.

373. Some are *dry*, as Wheat; others are *fleshy*, as the Apple. The two last characters, dry and fleshy, are of subordinate importance.

SIMPLE FRUITS.

Formed of a single carpel in each flower.

1. *Dehiscent.*

374. *The Legume* or Pod. This is a two-valved pericarp, having a dorsal and a ventral suture (365), along the latter of which a placenta (326) bearing the seeds is placed, as the Pea, the Bean, and the rest of the Leguminosæ. (See Fig. 30.)

Fig. 30.

375. In the Cassias there are spurious transverse dissepiments, and some of this genus, and a few more of the order, are indehiscent. The Legume is *lomentaceous* when there are transverse articulations or joints, as in Ornithopus; and in this case the Legume is indehiscent in the line of the suture, but divides in the line of the joints.

2. *Indehiscent.*

Fig. 31.

376. *The Drupe.* This is a fleshy fruit, containing a stone or nut, as the Peach, the Plum, the Apricot, &c. In it the epicarp, sarcocarp, and endocarp are very distinct; the sarcocarp being considered an enlarge-

2. *Indehiscent.*

(1.) Dry.

384. *The Gland.*—This is a one-celled, and frequently one-seeded, pericarp, often contained in a scaly involucre called a *cupula.* The ovary had originally three cells, and several ovules which have become abortive. The Oak (*Quercus*), the Hazel (*Corylus*), and other Cupuliferæ. It is often called a Nut. (See Fig. 35. the Hazel.)

385. *The Samara.*—This has one or two cells, and is dilated at the apex or sides into a kind of wing or membranaceous appendage. It is considered a kind of capsule by some. The Ash (*Fraxinus*), the Maple (*Acer*), and the Elm (*Ulmus*).

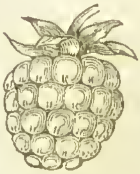
(2.) Fleshy.

386. *The Pome,* or Melonida of Richard.—This is formed of a semi-inferior ovary, consisting of from two to five carpels, the pericarp being fleshy, and formed of the calyx and ovary united. The Apple and the Pear, and the rest of the Pomaceæ, are examples. (See Fig. 36.)

Fig. 35.

Fig. 36.

Fig. 37.



(3.) Pulpy.

387. *The Pepo*, or Peponida of Richard.—In this fruit the cells are remote from the axis or centre; the margins of the carpels are not united; and their sides are not much turned inwards. The placentæ are parietal, and the seeds are scattered through a juicy pulp deposited in the cells. The pericarp is the thick external covering. The Cucumber, the Melon, the Gourd, and other Cucurbitaceæ.

388. *The Hesperidium*, or Orange.—In this fruit the thick integument is the pericarp; the cells or divisions into which the fruit can be easily divided are the carpels, the seeds being scattered through them; and the pulpy matter is not mesocarp, as might be imagined, but a peculiar deposition in the cells which contain the seed. The Orange and Lemon (*Citrus aurantium* and *C. medica*) are examples.

389. *The Berry.*—This is a pulpy fruit, with the seeds scattered loosely in the pulp. Gooseberry, Grape, Currant.

MULTIPLE FRUITS.

Several carpels in one flower, remaining distinct in the matured state.

1. *Dehiscent.*

390. *The Follicle.*—This is a membranous one-celled, one-valved pericarp, opening longitudinally by a ventral suture (365), to which is attached a placenta bearing the seeds, and having no dorsal suture;

ment of the cellular substance of the carpel or leaf. (See Fig. 31. the Drupe of the Cherry.)

377. *The Nut.*—This resembles the preceding, except in not being fleshy. It includes the Almond, Walnut, &c., which have a very thin woody pericarp. Many botanists consider it a Drupe.

378. *The Achenium.*—A dry one-seeded pericarp, which does not adhere to the integument of the seed, as in the Thistle and other Compositæ. It is surmounted by the pappus or seed-down (349), as is seen in the seed of Dandelion, with which every one is so familiar.

379. *The Caryopsis.*—This is a dry one-seeded pericarp, adhering closely to the integument of the seed, as in Rice, Oats, Wheat, and all the Gramineæ. In general it is impossible to distinguish the pericarp from the seed in the Caryopsis.

COMPOUND FRUITS.

Formed of several carpels united into one pistil.

1. *Dehiscent.*

380. *The Capsule.*—This is a dry, many-celled pericarp, of a coriaceous or membranous nature, splitting into several valves (364), as the Thorn Apple (*Datura Stramonium*), or dehiscing by pores (369), as the Snap-Dragon (*Antirrhinum*) and the Poppy; the latter of which, by the contraction of the dissepiments, has only one cell. The Catchfly or Campion (*Lychnis*), and the rest of the Caryophylleæ, have capsules which open at the top by the

Fig. 32.

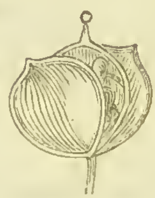
separation of the teeth which closed them. (See Fig. 32. the Capsule of Lychnis.)

381. Henbane (*Hyoscyamus*) and Pimpernel (*Anagallis*) have capsules which dehisce transversely. M. Richard applies the term *pyxidium* to this kind of capsule.

382. *The Siliqua* or Pod.—This is an oblong pericarp of two valves, somewhat resembling the Legume. It has two cells, separated by a longitudinal dissepiment, parallel to the valves. This dissepiment is considered a false or spurious one, being formed by an expansion of the placentæ. The seeds are ranged, alternately, along each edge of the dissepiment, and on each side of it, so that there are four rows of seeds. Wallflower, Turnip, Cabbage, and many of the Cruciferæ. (See Fig. 33.)

Fig. 33.

Fig. 34.



383. *The Silicula*, or pouch, differs from the preceding only in being very short, or even broader than it is long. Shepherd's Purse (*Capsella ; Thlaspi*, Linn.) (See Fig. 34.)

399. The integuments, taken together, constitute what is called the *episperm*, and they are frequently incorporated together, so that there appears to be only one covering. The primine (336) of the ovule becomes the *spermoderm*, or *testa* of Gaertner. The secundine (336) receives the name of *mesosperm*; and the others (339) are called *endopleura*. The episperm is very distinct in the Pea and Bean; and the hilum is always placed on it. (See Fig. 38, in which the dark part is the hilum.)

Fig. 38.

400. The *albumen* is the peculiar mucilaginous or amylaceous substance found in many seeds between the integuments and the embryo. It has also received the names of *perisperm* and *endosperm*.

401. The albumen forms a great part of the seed in monocotyledonous plants: these have only one cotyledon, which is generally small, as in the Wheat and other Gramineæ. The albumen affords nourishment to the young embryo during the first stage of its growth, becoming soluble and of a saccharine nature. It is a store of nutritious matter, laid up during the growth of the ovule, being formed of that part of the *liquor amnios* (339), which was not required to bring the seed to perfection. The white matter in the Cocoa Nut is the albumen, and the fluid is the residue of the liquor amnios, which is very plentiful in this plant.

402. The albumen may, in general, be eaten with perfect safety, even in families of a dangerous nature, as the Euphorbiaceæ. In Wheat, Oats, and Barley, it consists principally of starch and gluten, and is very wholesome.

Fig. 39.

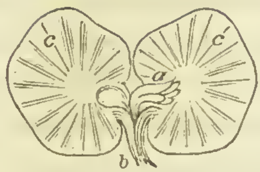


Fig. 40.

403. The *embryo* is the organized body which lies innermost, and is the essential part of the seed, being the proper rudiment or germ of the new plant. (See Figs. 39, 40.) It consists of the cotyledons (*c c*), the gemmule or plumule (*a*), and the radicle (*b*).

404. It is sometimes surrounded by a sack-like body, called *vitellus* or yoke, supposed to be formed of the quintine of the ovule (339).

405. The *cotyledons*, or seed-lobes surround the gemmule and radicle, and may be considered the rudiments of the first leaves which elaborate the sap and supply the young plant with nutritious matter, before it can put forth proper leaves to perform this function. In seeds which have little or no albumen, the cotyledons are filled with nutritious matter, which supply the young plant, as in the Pea. Plants are divided into two classes, according as they are provided with, or destitute of, cotyledons in their seeds—the Cotyledoneæ and the Acotyledoneæ.

406. When there is only one cotyledon, the plant is called *Monocotyledonous*, as in Wheat, Barley, Rice, &c. In monocotyledonous seeds the gemmule is enclosed within the cotyledon, which forms a sheath called *coleoptilon*; and the cotyledon is converted in germination into a thick leaf.

there are more than one in each flower. Peony, Periwinkle (*Vinca*), and many of the Apocyneæ.

2. *Indehiscent.*

391. *The Strawberry.*—This fruit consists of a number of minute pericarps, called sometimes Acheniums, at other times *Acini*, placed upon a pulpy or fleshy receptacle or gynophore, commonly called the fruit. Strawberry. In the Raspberry the small spherical juicy bodies are the carpels. (See Fig. 37. page 107.)

392. The fruit of the Ranunculus resembles the Strawberry, except in the receptacle not being fleshy.

AGGREGATE FRUITS.

The fruits of several flowers united into one mass.

393. *The Cone* (Strobilus).—This is the catkin or amentum (244) ripened and indurated. The seeds are found in the axillæ of the bracteæ or scales. Fir-top. (See Fig. 18. page 76.)

394. *The Sorosis* of Mirbel.—This term is applied to the Pine-Apple (*Bromelia ananas*), which consists of several fruits growing together into a thick fleshy substance. The fruit of the Mulberry is of this kind. In this case the flowers were in the form of a dense spike, and the fruits, or pericarps, grow together from their vicinity to each other.

395. *The Syconium* of Mirbel.—This is the fruit of the Fig-tree (*Ficus carica*). It consists of the receptacle or apex of the peduncle, or of an involucre di-

lated into a hollow body, fleshy interiorly, and containing a number of small hard seeds or acheniums.

III. THE SEED.

396. This is the ovule, impregnated and arrived at maturity. It is found within the pericarp, and consists of the integuments or coverings, the albumen, and the embryo. The terms used to express the different positions of the ovule apply also to the seed (334). See Fig. 38. the seed of the Bean (par. 399). In Fig. 39. (par. 403.) the skin or episperm (399.) has been removed. In Fig. 40. the two lobes, which were united by means of the little conical body between them, are removed, and the most essential part of the seed is left —the gemmule and radicle (413–14).

397. It is attached to the placenta or trophosperm by the funiculus or podosperm, each of which grows along with the ovule. The hilum or umbilicus, where this attachment takes place, is considered the base of the seed, and at this point the vessels which convey nourishment enter the seed. These vessels, clustered together, form the funiculus, and they derive their origin from the placenta. The funiculus is well seen in the pod of the Pea (Fig. 30. par. 374.)

398. When the placenta expands around the seed, it forms a covering called *arillus*, as in the Nutmeg (*Myristica Moschata*), the mace of which is the arillus. The Spindle-tree (*Euonymus*) has an orange-coloured arillus enveloping the seed. M. Richard observes, that the arillus never occurs in plants with a monopetalous corolla.

407. It has been found that *monocotyledonous* plants are *endogenous* (83).

408. When there are two opposite cotyledons, as in the Pea and Lupine; or several in a whorl, as in some of the Coniferæ; the plant is called *Dicotyledonous*. In this case the cotyledons are converted, during germination, into two leaves, affording nutriment to the young plant. (See Fig. 39.)

409. It has been found that *dicotyledonous* plants are *exogenous* (109).

410. The cotyledons, when filled with nutritious matter, frequently remain under ground during germination, in which case they are called *hypogean*, as in the Pea.

411. When the cotyledons appear above ground, and assume the form of leaves, they are *epigean*, as in the Lupine.

412. The leaves into which the cotyledons are converted are called *Seminal*, and differ in figure from the proper leaves of the plant.

413. The *Gemmule* (*a*, Fig. 40.) is the rudiment of the stem, growing upwards, and becoming stem and branches, &c. It is often undistinguishable till germination has made some progress, being closely adherent to the cotyledon, as in monocotyledonous plants. It is very well seen between the cotyledons of the Pea or Bean, in which it is formed of several minute leaves closely folded together. These become the first or primordial leaves. The gemmule may be regarded as the first bud of the new plant, ready to be developed when its situation and other circumstances are favourable. (See Fig. 40.)

414. The *Radicle* (*b*, Fig. 40.) is the rudiment of the root, and is continuous downwards with the gemmule. It is always simple and undivided, and in the dicotyledonous seed is of a conical shape with the apex inferior. It always points towards the micropyle (338), and invariably grows towards the centre of the earth, forming the root of the new plant.

415. Those plants in which the radicle is free and naked, not being enclosed in any sheath (excepting, of course, the episperm) were called *exorhizæ* by the late M. Richard, and correspond to the exogenous or dicotyledonous plants of other authors; as the Bean, in which the free pointed radicle is well seen.

416. Those in which the radicle is enclosed in a sheath were called *endorhizæ* by Richard, and correspond to the endogenous or monocotyledonous plants of other authors, as Wheat.

417. In the Coniferæ and Cycadeæ the radicle is incorporated in a peculiar manner with the albumen; These were called *synorhizæ* by Richard, but are included among the exogenous plants of other authors.

418. The part between the radicle and gemmule is called the *collet* or neck (28), and is the point where the ascending and descending parts meet; the root elongating downwards from it, and the stem elongating upwards from the same spot.

419. The embryo is *homotropous* or *orthotropous* when the radicle is at the hilum or base of the seed (397), as in the Pomaceæ, the Solaneæ, &c. In this position it is sometimes called erect; and the nucleus is inverted.

420. The embryo is *antitropous* or *inverted* when the

cotyledons are next the hilum, as in the Thymeleæ, Urticæ. In this case the radicle is remote from the hilum.

421. The embryo is *heterotropous* when it lies across the hilum, as in Primulaceæ.

422. The embryo is *amphitropous* when carried round the albumen, so that the two extremities approach, as in the Caryophylleæ.

423. There is a peculiar class of plants which are constantly destitute of floral envelope, sexual organs, and seed. They are reproduced by means of minute bodies, called *sporules*, which, indeed, may be considered as the seeds, but bear no analogy in mode of formation or in structure to the seeds which have just been examined.

424. They are called *Acotyledonous*, from being destitute of cotyledons; *Inembryonate*, from being destitute of an embryo; *Asexual*, *Agamic*, and *Cryptogamic*, because they have no sexual organs, or because, if these do exist, they cannot be detected; and *Cellular*, because they are found to consist chiefly of cellular tissue, or are destitute of spiral vessels.

425. These differ in many other respects from phenogamic or flowering plants; and consist chiefly of the following tribes: Ferns (*Filices*), Mosses (*Musci*), Mushrooms (*Fungi*), Sea-Weeds (*Algæ*). I shall say nothing more at present of these, as they will be fully described in their order along with the other natural families of plants.

CHAP. V.—PROPAGATION OF PLANTS.

426. This is effected in three ways: 1st, By means of the seed, which, when placed in a fit situation, becomes a new plant, of the same species as that which produced it, though frequently of a different variety*. The commencement of the growth of the seed is called *germination*. 2dly, By means of buds, which are also capable of producing new plants. In this case, it is always the same variety that is produced. 3dly, By means of slips or branches, which, when treated in a particular manner, are capable of becoming entire and independent plants, when separated from the parent: See par. 121. This is called propagation by slips or layers; and also includes *grafting;* and in this case, also, we always obtain the same variety. This latter mode of propagation might be included along with the second, thus making two principal modes of propagation—by seeds and by buds.

1. *Germination.*

427. A perfectly formed seed may be considered a young plant, the vital energies of which are in a dormant or latent state, but ready to be excited to action when the appropriate stimuli are applied; and containing a quantity of matter in a state to be easily formed

* Plants are divided into Genera, Species, and Varieties. Each genus includes many species, and each species many varieties. The varieties of any species differ in particulars which are not deemed of much importance, such as colour, size, &c., and a seed always produces a plant of the same genus and species as that of the parent, but frequently of a different variety. See par. 506, et seq.

into proper nutriment, and applied to its support before it is able to provide for itself.

428. Seeds possess a large quantity of carbon. This substance, by its antiputrescent qualities and hardness, prevents the seed from undergoing putrefaction, and thus preserves it for a great length of time. All that is necessary for preserving seeds, is, to prevent germination or putrefaction. For this purpose, they must be carefully excluded from the action of heat and moisture, and other chemical agents.

429. Four conditions are necessary for the process of germination,—the presence of water, of heat, and of air, and the exclusion of light.

430. *Water* most probably acts in four ways: it softens the integuments, and renders them capable of being burst by the swollen embryo; dissolves the nutritive matter contained in the seed, thus reducing it to a fit state for being absorbed for the nutrition of the embryo; conveys in solution nutritive particles from other sources; and by being decomposed, furnishes two important ingredients in the composition of vegetables.

431. The *air*, by means of the oxygen which it contains, effects a chemical change on the farina of the albumen, or that deposited in the cotyledons. The oxygen combines with the carbon, and forms carbonic acid, which escapes; thus, the proportion of oxygen and hydrogen being increased by the expulsion of the carbon, the farina is converted into a semi-fluid substance, of a saccharine or mucilaginous nature, consisting of starch, gum, and sugar, well adapted for the nutrition of the plant in its infant state.

432. *Heat* always promotes chemical combination and decomposition, and thus assists the action of the water in dissolving the hard parts of the seed, and that of the air in its part of the process. Most probably heat also acts as a general stimulus to the absorbents in the seed. Seeds cannot be made to germinate in very cold weather, except by the application of artificial heat.

433. *Light* is unfavourable to germination, because it disposes to an accumulation of carbon in the seed, and a consequent hardening of the parts (191); or rather prevents the expulsion of carbon, and consequent softening of the parts, which is necessary that they may be taken up and applied to the use of the plant.

434. From the operation of these causes, it will be seen why seeds planted too deeply in the earth do not germinate. The air has not access to them, and therefore, from the want of this important stimulus, they remain torpid. Hence it is that earth newly dug up frequently becomes covered with weeds, the seeds of which soon germinate when exposed to the air.

435. Placing seeds at a certain depth in the earth, excludes them from the access of light, which is so injurious to germination; insures a supply of moisture, which would not remain with them were they placed at the surface; protects them from the wind, and from the attacks of animals; and enables the roots to take a firm footing in the soil.

436. When germination has commenced, the seed becomes soft, and swells; carbonic acid is disengaged, and oxygen absorbed; the particles of the episperm lose their cohesion, and it is burst to make way for the

elongation of the embryo; the radicle elongates and descends, often attaining a considerable length before the gemmule has made any progress, and soon exercising its function of absorbing food; the albumen is gradually absorbed, and disappears; the cotyledons expand and become seminal leaves, which afford nourishment to the young plant, in the first stages of its existence, by elaborating the sap, and wither when the proper leaves of the plant have unfolded—or remain under the surface, are gradually absorbed, and disappear; the gemmule or first bud gradually unfolds, and enlarges; the primordial leaves and stem appear; and we now have a young plant—a living being, able to provide its own sustenance; to elaborate that sustenance, and to apply it to its increase, and to the formation of those wonderful organs by which it is enabled to perpetuate its species.

437. In the operation of malting, the object is to convert the farina or hordein (460) of the albumen into sugar. For this purpose the seed is made to germinate: and this process is stopped at that point at which it has been found there is the greatest quantity of saccharine matter in the seed. Were germination allowed to proceed further, the saccharine matter would be taken up for the nutrition of the young plant, and its nature completely altered.

2. *Propagation by Buds.*

438. Plants are propagated by buds in four different ways: 1. by means of the bulbs which grow at the base of the scales in the bulbous root, as in the Snowdrop or Lily; these bulbs are soon detached from the pa-

rent bulb, and become independent plants: 2. by means of the bulbils which grow upon the stem in the axilla of the leaves, as in the Coral-root (*Dentaria bulbifera*), and in the Orange Lily (*Lilium bulbiferum*); or in the place of the flowers, as in the Mountain Garlic (*Allium carinatum*): 3. by means of the buds or small bulbs which grow at the margins of the leaves in the *Bryophyllum*, and the Bog Orchis (*Malaxis paludosa*): and 4. by means of the minute buds or eyes found in the tubercles of various plants, as the Potato (*Solanum tuberosum*).

439. All these buds resemble seeds in this, that when detached from the parent, and placed in the earth, they produce new plants. They differ from seeds, in not being formed by sexual organs; in not being able to preserve their vitality for such a length of time; in not having distinct parts, such as radicle, gemmule, and cotyledons, being merely extensions of the substance of the parent; and in always producing the same variety. Hence the advantage of propagating the Potato by buds; we have found a variety well adapted for use as an article of food, and we can ensure its reproduction. If grown from a seed, a very different variety might be produced, which would not have the same nutritious properties.

440. Alpine Meadow-grass (*Poa alpina*), and Viviparous Alpine Bistort (*Polygonum viviparum*), frequently bear little buds in their spikes. All plants which increase by buds or bulbs produce few seeds, and are called *viviparous*.

3. *Propagation by Layers and by Slips.*

441. *Propagation by layers* consists in surrounding a young branch with moist earth, in which case it throws out roots, and very soon becomes an independent plant. It is customary to make a small incision at the part placed in the earth, or to pass a ligature round it. This intercepts the descending sap, which, by being accumulated, excites the latent germs; and these, being developed in the earth, become roots (121).

442. Sometimes the branch is bent downwards and fastened in the earth, as in the Vine, which is always propagated in this way; and many plants propagate themselves naturally in this way, the stems or branches lying on the earth, and taking root where they come intimately into contact with it, as the Currant-bush and Laurel. At other times the branch is surrounded with earth in its natural position, and detached when it has taken root. Propagation by runners, as in the Strawberry, may be considered somewhat analogous.

443. *Propagation by slips* much resembles the preceding mode. The only difference is, that the branch or slip is detached from the parent before being made to put out roots. The slips or cuttings of most trees that have a light white wood, as the Willow, the Ash, or the Poplar, easily take root when placed in the earth; and indeed the Willow is reproduced only in this way. It is difficult to propagate by slips woods which are very dense and contain much resin, as the Fir and Oak.

444. These processes for the propagation of plants, are, in many cases, preferred to multiplying by seed.

Propagation by slips or layers always produces the same variety as that from which the slip is taken; so that, if we have a plant which produces good fruit, by propagation in either of these modes, several may be raised bearing fruit equally good. The tree is always more speedy in bearing fruit when formed in this way, than when grown from a seed.

445. It is a remarkable fact, and one which is turned to good account in the cultivation of fruit trees, that, when the tree is raised in this way, the number of seeds in the fruit is almost always less than when produced from a seed, so that more of the juices and strength of the plant are expended in perfecting this fruit. The Vine, when raised by seed, has four seeds in each grape; bnt freqnently only two, when propagated by layers. The Sugar-cane, which is propagated in a nearly similar manner (64), bears no seed at all, but the other parts of the plant are richly developed.

446. Thus, by a singular control over their mede of growth, which is also exhibited in the case of viviparous plants, vegetables are enabled to adapt the number of seeds to the demand for them—the demand depending on the number of other sources for propagation which they may possess.

GRAFTING.

447. This operation consists in uniting a part of one plant to another. The branch or bud which is transferred is called the *graft* or *scion;* and the tree on which it is placed is called the *stock*.

448. The union of the graft and the stock is effected by the cambium, or proper juice in the bark; and hence it is necessary that the graft have a piece of fresh bark, and that this be placed in the bark of the stock, so that the vessels in each may unite. The cambium exudes from the edges of each, becomes organized, and thus brings about a complete union. Grafting succeeds only when the stock and graft belong to the same natural family.

449. By grafting we are enabled to accelerate considerably the fructification of various trees, improve much the quality of the fruit, and preserve and multiply particular varieties of trees which may be deemed valuable. An Apple-tree does not in general produce fruit till it is ten years of age; but if a scion of a seedling tree be grafted on one that has already borne fruit, it will bear fruit in the third or fourth year. "Suppose two acorns of a new species of oak received from a distant country; sow both, and after they have grown one or two years, cut one of them over, and graft the part cut off on a common oak of five or six years' growth; the consequence will be, that the whole nourishment of this young tree of five years' growth being directed towards nourishing the scion of one or two years, it will grow much faster, and consequently arrive at perfection much sooner, than its fellow, or its own root left in the ground. A French author found the advantage of this practice, in the case of a new species of ash, to be as five to one in point of height."—*Loudon's Encyclopædia of Gardening.* The quality of the fruit is improved by the non-development of many of the seeds of grafted plants, which enables them to expend more

of their energies in enriching the fruit. By grafting, we can supply a branch of an old tree with a plentiful quantity of sap, more healthy and nourishing than it could get from the tree on which it grew, and thus for a time it is more vigorous, and produces richer fruit. "As the graft is merely an extension of the parent plant from which the scion came, and not properly speaking a new individual, so it is found to be the best method of propagating approved varieties of fruit-trees, without any danger of altering the quality of the fruit." —"Till lately, grafting was confined to the ligneous plants, but it is now successfully practised on the roots and shoots of herbaceous vegetables; and the Dahlia is grafted by the root; the Melon on the Gourd; the Love-apple on the Potato; the Cauliflower on the Cabbage, &c. by the shoot."—*Loudon.*

SECTION IV.

CHEMICAL COMPOSITION AND SECRETIONS OF VEGETABLES.

450. VEGETABLES consist chiefly of three elementary bodies, Carbon, Oxygen, and Hydrogen. Nitrogen is found in some, and minute portions of sulphur, phosphorus, potassa, soda, lime, magnesia, alumina (argillaceous earth), silica (sandy or flinty earth), and iron, may be found in most of them. These, however, bear a small proportion to the three first, which make up the greater part of all vegetables.

451. These simple materials, by their combination in different proportions, compose the different solid parts and fluid secretions which we find in plants.

452. From animals, in respect to their chemical composition, vegetables differ in being mostly destitute of nitrogen, an element which enters largely into the composition of animal compounds. Owing to the presence of nitrogen, and the greater variety and more complex nature of animal products, they are much more readily decomposed than those of the vegetable kingdom. The decomposition of the former is generally accompanied with the production of ammonia, from the union of their hydrogen and nitrogen, which seldom occurs in the decomposition of vegetables.

453. Between vegetable or animal and inorganic substances, there is a marked difference. The latter generally contain some leading element which characterises the compound, being different from those entering into the composition of other inorganic bodies. For example, sulphur is the base of sulphuric acid, and in point of composition distinguishes it from carbonic acid, which has for its base a totally different elementary substance. Organic substances consist chiefly of the same elementary bodies, differing in the proportion in which these are present; and are also remarkable for their tendency to spontaneous decomposition. When their elements are no longer held together by the principle of life, they are resolved into carbonic acid, water, carbonic oxide, and the different kinds of carbureted hydrogen. Ammonia is also formed when nitrogen is present. The carbon and hydrogen have a constant tendency to unite with oxygen to form car-

bonic acid and water ; but as there is never a sufficient quantity of oxygen to convert all the carbon into carbonic acid, and all the hydrogen into water, the carbureted hydrogen, which requires no oxygen, and the carbonic oxide, which requires less than the carbonic acid, are formed.

454. It has been ascertained by MM. Gay-Lussac and Thenard, that those vegetable products in which the oxygen and hydrogen exist in the proportions in which they unite to form water, are of a mild and inoffensive nature, being neither acid, resinous, nor oily; that when there is more hydrogen than is necessary to form water with the oxygen, the product is resinous or oily; and that when there is more oxygen than would be necessary to form water with the hydrogen, the product is in general of an acid nature. Besides these, there is a newly discovered class of vegetable principles called alkalis, many of which contain a considerable quantity of nitrogen; and there are several vegetable compounds which cannot be included in any of the preceding classes. Under these heads, we shall now proceed to describe the various products of the vegetable world.

CHAP. I.—VEGETABLE COMPOUNDS IN WHICH THE HYDROGEN AND OXYGEN ARE PRESENT IN THE PROPORTIONS IN WHICH THEY FORM WATER.

1. WOOD.

455. This forms the principal part of most vegetables. As we find it in trees, it contains many of the

juices of the vegetable; by digesting any kind of wood in boiling water and then in alcohol these are removed, and the pure woody part remains, called *woody-fibre* or *lignin*. This is a fibrous substance destitute of taste and smell, and, if perfectly dry, not altered by exposure to the air. When moist it is decomposed, carbonic acid and water being produced. The same products result from its combustion. When exposed in close vessels to a strong heat it is resolved into acetic acid (pyroligneous acid) mixed with an empyreumatic oil, carbonic acid, carbureted hydrogen, water, and a fine charcoal which remains. The charcoal retains the figure and texture of the wood from which it is made. Lignin contains also a little carbonate of lime. It consists of carbon, oxygen, and hydrogen, in the following proportions, according to Dr Prout :—

Carbon, ...	50
Oxygen, ...	44.45
Hydrogen, ...	5.55
	100 parts.

2. GUM.

456. This substance exudes in a fluid form from certain trees, and soon becomes hard when exposed to the air. It is white, pale straw-coloured, or even colourless, transparent, tasteless, and very brittle. It is very soluble in water, forming mucilage, but insoluble in alcohol, which decomposes mucilage, combining with the water and precipitating the gum. The elements which enter into its composition are nearly in the following proportions :—

Carbon, . , . .	42.23
Oxygen, ...	50.84
Hydrogen, . . .	6.93
	100 parts.

There is also present a small proportion of the carbonate and phosphate of lime, and, it has been lately said, some nitrogen.

457. Gum is obtained principally from the *Acacia Arabica;* the Plum and Cherry trees also contain it; and the *Astragalus tragacantha* affords a peculiar kind of gum.

458. Mucilage, or a substance resembling it much, is found in a great number of vegetables,—as the Marsh-mallow, Lichens, some Algæ, bulbous roots, Linseed, &c. Gum and mucilage are very nutritious. They are also useful for suspending colouring matters in water, and are hence used in calico printing. The mucilage from Lichens has been employed for this purpose.

3. STARCH *(Fecula).*

459. This substance does not exist quite free in the vegetable, but as it can be easily separated from the principles with which it is associated, it may be considered as mechanically mixed rather than chemically combined with them. To procure it from wheat, the grain must be steeped in cold water till it becomes soft, and gives a milky juice when squeezed; it is then to be put into linen bags and pressed in water. The milky juice which exudes contains the starch, which is soon deposited in the form of a white powder. It may also be obtained from potatoes, by rasping them in a

tions. The starch or farinaceous matter in the seed is converted during germination into sugar, which appears to be necessary for the growth of the young plant at that stage. Sugar is composed of carbon, oxygen, and hydrogen, in the following proportions, according to MM. Gay-Lussac and Thenard :—

Carbon, ...	42.47
Oxygen, ...	50.63
Hydrogen, ...	6.90
	100 parts.

Prout's analysis led to nearly the same results; that of Berzelius is a little different. It will be observed how trifling a difference, in point of composition, there is between sugar and starch; and this partly explains the facility with which starch is converted into sugar, both during malting and by the action of dilute sulphuric acid upon it. Indeed, it is not improbable that the difference in these two vegetable compounds may depend more on the presence of a minute quantity of some salt or other matter, or on a difference in the mode of arrangement in the particles, than on the almost imperceptible variety of the proportions of oxygen, hydrogen, and carbon.

465. Sugar may be obtained also from the American Maple (*Acer saccharinum*), the sap of which, when neutralized by lime, yields about one-fortieth part of sugar. The juice of the Grape (*Vitis vinifera*) affords sugar when treated with pot-ashes and evaporated. Manna, which exudes from the *Fraxinus Ornus*, a species of Ash, is a substance of a saccharine nature, resembling the sugar of Grapes. Sugar may be pro-

cured from the root of the Common Beet (*Beta vulgaris*) by boiling it, and evaporating the expressed juice. In many fruits there is a kind of sugar which is not crystallizable. The sugar in molasses is of this nature. The stalk of Indian Corn furnishes a sugar of this sort. The following are the plants which furnish the greatest quantity of sugar :—

Sugar Cane (*Saccharum officinarum*).
Maple (*Acer saccharinum*).
Sycamore (*Acer pseudo-platanus*).
Birch (*Betula alba*).
Walnut (*Juglans alba*).
Ash (*Fraxinus ornus*).
Cocoa-tree (*Cocos nucifera*).
American Aloe (*Agave Americana*).
Fig-tree (*Ficus carica*).
Dulse (*Fucus palmatus ; Halymenia palmata*, Hook.)
St John's Bread (*Ceratonia siliqua*).
Cow Parsnip (*Heracleum sphondylium*).
Common Parsnip (*Pastinaca sativa*).
Carrot (*Daucus carota*).
Beet (*Beta vulgaris*).
Turnip (*Brassica rapa*).
Parsley (*Apium petroselinum*).
Onion (*Allium cepa*).
Bamboo (*Arundo bambos*); furnishes the *Sacar nambu* of the Indians.
Indian Corn (*Zea mays*).
Euxine Rhododendron (*R. ponticum*), from the flower.
Grape (*Vitis vinifera*).

The nectaries of flowers, and all sweet tasted fruits, contain sugar. Many of the Palm trees furnish a highly saccharine juice: See *Palmæ*.

large quantity of water: when the fibrous parts have been removed, the starch will be found suspended in the water, and will soon be deposited.

460. Starch is insoluble in cold water, and with warm water forms a sort of transparent jelly. It is also insoluble in alcohol. When boiled in very dilute sulphuric acid, upon filtering and evaporating the solution after the acid has been neutralized by lime, the starch is found to be converted into a substance of a saccharine nature. This conversion of starch into sugar takes place spontaneously in germination and in malting. Starch consists of—

Carbon, ...	43.55
Oxygen, ...	49.68
Hydrogen, ...	6.77
	100 parts.

and a little saline and earthy matter. Proust found in Barley a peculiar principle which he called *Hordein;* this Dr Thomson regards as a modification of starch.

461. Starch is contained in a great number of vegetable substances, and principally in seeds and tuberose roots. It is found in the roots of Bistort (*Polygonum bistorta*), White Bryony (*Bryonia alba*), Burdock (*Arctium Lappa*), Crowfoot (*Ranunculus bulbosus*). Broad-leaved, Sharp-pointed, and Water-Dock (*Rumex obtusifolius*, *R. acutus*, and *R. aquaticus*), Dropwort, (*Spiræa filipendula*), Earthnut (*Bunium bulbocastanum*), Dwarf and Common Elder (*Sambucus Ebulus* and *S. nigra*), Henbane (*Hyoscyamus niger*), *Iris pseudacorus*, and *I. fœtidissima*, Meadow Saffron (*Colchicum autumnale*), Masterwort (*Imperatoria ostruthium*), Deadly Nightshade (*Atropa belladonna*), *Orchis morio*, *O.*

mascula, *O. bifolia*, &c. (these furnish *Salep*), Wake-Robin (*Arum maculatum*). The roots of the *Iatropha manihot* furnish *Cassava*; the juice is highly poisonous, but the starch which they contain is perfectly innocuous when washed. Sago is a kind of starch procured from the pith of Palm trees, and also from the *Cycas circinalis*. The *Maranta arundinacea* furnishes a sort of starch, well known by the name of *Indian Arrow-root*.

462. Almost all seeds employed as food contain a large quantity of this substance. Wheat, Oats, Barley, Rice, &c. abound in it. Perhaps there are few plants which do not contain a quantity of starch in some part. Almost all perennial monocotyledonous roots contain a little.

4. SUGAR.

463. This substance exists in the sap of many vegetables; it is generally procured from the juice of the Sugar-cane (*Arundo saccharifera* or *Saccharum officinarum*). The juice is expressed from the cane by passing it between rollers, brought to a boiling heat, and mixed with a little lime, which neutralizes any acid that may be present. The liquid is then evaporated, and made to crystallize after the scum has been removed. The crystals are surrounded by a brownish liquid, *molasses or treacle*, which is separated by a mechanical process, and *muscovado* or *raw sugar* remains.

464. Sugar is soluble in cold water, in boiling water, and in alcohol; its other properties are too well known to require to be mentioned. It is very nutri-

469. They have a strong and fragrant odour, and a hot and acrid taste, and are volatilized by a temperature of 320°; when distilled along with water, rising in vapour at 212°. Little attention has been paid to the composition of volatile oil. According to Dr Ure, oil of turpentine consists of—

Carbon, ...	82.35
Oxygen, ...	9.80
Hydrogen, ...	7.85
	100 parts.

When purified by distillation, it has been found by some chemists to contain no oxygen.

470. The number of vegetables which afford volatile oil is very great. Almost every plant possessing any marked odour owes it to a volatile oil. The following are the principal volatile oils :

Oil of Cloves,	from the	Eugenia caryophyllata.
...... Cajeput,	....	Melaleuca leucadendron.
...... Cinnamon,	....	Laurus cinnamomum.
...... Lemons,	....	Citrus medica.
...... Oranges,	....	Citrus aurantium.
...... Anise,	....	Pimpinella anisum.
...... Juniper,	....	Juniperus communis.
...... Savine,	....	.... sabina.
...... Lavender,	....	Lavandula spica.
...... Sassafras,	....	Laurus sassafras.
...... Rosemary,	....	Rosmarinus officinalis.
...... Nutmeg,	....	Myristica moschata.
...... Caraway,	....	Carum carui.
...... Pennyroyal,	....	Mentha pulegium.
...... Spearmint.	....	.... viridis.
...... Peppermint,	....	.... piperita.
...... Turpentine,	....	Pinus sylvestris, et P. larix.

Oil of Chamomile,	from the	Anthemis nobilis.
...... Dill,	....	Anethum graveolens.
...... Fennel,	....	.... fœniculum.
...... Pimento,	....	Myrtus pimenta.
...... Rue,	....	Ruta graveolens.
...... Origanum,	....	Origanum vulgare.

3. CAMPHOR.

471. This is obtained by distillation from the wood of the *Laurus camphora* and the *Dryobalanops camphora*: the greater part of the camphor of commerce is obtained from the latter. It is obtained in cakes, of a white colour and crystalline structure. It is insoluble in water, but soluble in alcohol, acetic acid, and in the fixed and volatile oils. It consists of

Carbon, ...	78.02
Oxygen, . . .	10.40
Hydrogen, . . .	11.58
	100 parts.

It is found also in the volatile oils of Rosemary, Sage (*Salvia*), Lavander (*Lavandula spicata*), Marjoram (*Origanum majorana*), and several others.

4. WAX.

472. This substance resembles much the fixed oils, but is distinguished from them by its solidity and solubility in alcohol. It may be obtained in considerable quantity from the *Myrica cerifera* of America, by boiling the bruised berries in water. The wax collects on the top of the liquid, and becomes solid as it cools.

CHAP. II.—VEGETABLE COMPOUNDS IN WHICH THERE IS MORE HYDROGEN THAN WOULD BE NECESSARY TO FORM WATER WITH THEIR OXYGEN.

1. FIXED OILS.

466. These oils are obtained by expression from the seeds of many dicotyledonous plants. They generally retain part of the mucilaginous matter of the seed from which they are expressed, and hence acquire a peculiar flavour. They are found only in the seeds, except in the Olive (*Olea europea*), and the Bead-tree (*Melia azedarach*), in which cases the oil is situated in the pulpy matter surrounding the seed. When pure, which is seldom the case, they are transparent and colourless, and have little taste or smell. They are mild and bland, require a temperature of about 600° to make them boil, and leave a stain upon paper which is not removed except by a high temperature. They are very inflammable, and produce water and carbonic acid by their combustion. When passed through a red-hot tube, they give out carbureted hydrogen, olefiant gas, &c. Olive oil, according to the experiments of Gay-Lussac and Thenard, consists of—

Carbon,	77.213	or	10 equivalents	60	Olefiant Gas, 10 eq.	70
Oxygen,	9.427	...	1	8	Water, 1 eq.	9
Hydrogen,	13.360	...	11	11		
	100 parts.			79		79

467. The following are the principal kinds of fixed oil :—

Linseed oil,	from the	Linum usitatissimum et L. perenne.
Hemp oil,	....	Cannabis sativa.
Hazel-nut oil,	....	Corylus avellana.
Walnut oil,	....	Juglans regia.
Poppy oil,	....	Papaver somniferum.
Oil of Sesamum,	....	Sesamum orientale.
Olive oil,	....	Olea europea.
Almond oil,	....	Amygdalus communis.
Beech oil,	....	Fagus sylvatica.
Rape-seed oil,	....	Brassica napus et B. campestris.
Oil of Mustard,	....	Sinapis nigra et S. arvensis.
Cucumber oil,	....	Cucurbita pepo et C. melopepo *.
Castor oil,	....	Ricinus communis or Palma Christi.
Tobacco oil,	....	Nicotiana Tabacum et N. rustica.
Plum-kernel oil,	....	Prunus domestica.
Grape-seed oil,	....	Vitis vinifera.
Butter of Cacao,	....	Theobroma Cacao.
Laurel oil,	....	Laurus nobilis.
Palm oil,	....	Elais guineensis.

The fruit of the Bead-tree (*Melia*) also furnishes a considerable quantity of oil.

2. VOLATILE OILS.

468. These are not confined to any particular part of the plant, but are found in the root, the stem, the leaves, the flowers, or the rind of the fruit. They are characterized by possessing some strong and peculiar odour; and the odours of different plants seem to depend upon some volatile oil. They are obtained by placing the vegetable in water, and distilling; the oil rising in vapour along with the water, and being condensed in the receiver.

* The *Jolliffia Africana*, belonging to the same family, furnishes a great quantity of oil, resembling olive oil.

This is the substance called *Myrtle wax*. The upper surface of many leaves is covered with a kind of wax; and, according to Proust, it covers the rinds of Raisins, Plums, Oranges, and such fruits. A species of Palm (*Ceroxylon andicola*) furnishes a considerable quantity of wax. According to MM. Gay-Lussac and Thenard, wax consists of

Carbon, ...	81.784
Oxygen, . . .	5.544
Hydrogen, . . .	12.672
	100 parts.

According to Dr Ure, there is a little more oxygen and a little less carbon and hydrogen.

5. RESINS.

473. Resins exude spontaneously from many trees: they are in combination with a volatile oil, which is driven off by a gentle heat, and a solid substance, which is resin, remains. Resin is insoluble in water, but soluble in alcohol. It is very inflammable, burning with a black smoke, and is melted by a moderate heat. Common resin, according to MM. Gay-Lussac and Thenard, consists of

Carbon,	75.944	According to Dr Ure	75.0
Oxygen,	13.337	....	12.5
Hydrogen,	10.719	....	12.5
	100 parts.		100 parts.

474. There are many varieties of resin. Common resin is obtained from the different species of Fir, the *Pinus sylvestris*, *P. Abies*, *P. Larix*, *P. balsamea*, &c.

The first of these yields common turpentine, consisting of resin (in this case called *rosin*), and oil of turpentine; the *P. Larix* gives Venice turpentine; the *P. balsamea*, Canada balsam; the *P. Abies*, musk or frankincence. Strasburgh turpentine is obtained from the *Pinus picea*: mastick is obtained from the *Pistachia lentiscus*; sandarach from the *Juniperus communis*; copal (much used for varnishing) from the *Rhus copallinum*; elemi from the *Amyris elemifera*.

475. Balsams consist of resin, volatile oil, and benzoic acid. The principal are, opobalsam or balm of Gilead, the produce of the *Amyris Gileadensis*; copaiva, obtained from the *Copaifera officinalis*; balsam of Tolu, from the *Toluifera balsamum*; balsam of Peru, from the *Myroxolon Peruiferum*; benzoin, from the *Styrax benzoina*; storax, from the *Styrax officinale*; dragon's-blood, from the *Calamus Draco*, *Pterocarpus Draco*, and *Dracæna Draco*.

476. Gum-resins are intermediate in their properties between gum and resin, of which they seem to be compounds. The most leading are, ammoniac, from the *Heracleum gummiferum*; aloes, from the various species of *Aloe*; assafœtida, from the *Ferula assafœtida*; galbanum, from the *Bubon galbanum*; olibanum, from the *Juniperus lycia*, or from the *Boswellia serrata*; opoponax, from the *Pastinaca opoponax*; scammony, from the *Convolvulus scammonia*; gamboge, from the *Staligmitis gambogioides*; gum-guaiac, from the *Guaiacum officinale*; myrrh, from an unknown plant; euphorbium, from *Euphorbia officinalis*. Opium, from the *Papaver somniferum*, is sometimes called a gum-resin.

6. CAOUTCHOUC.

477. This substance, commonly known by the name of Indian Rubber, is the juice of the *Haevea*, which grows in the Brazils. It may also be obtained from the *Urceola elastica*, the *Iatropha elastica*, and other Euphorbiaceæ, and the *Artocarpus integrifolia* and *Ficus elastica*. When newly exuded, caoutchouc has a whitish-yellow colour; but it turns black when exposed to the air for a while. It is distinguished by its great elasticity. When exposed to heat, it softens and swells, and emits an odour like that of burnt wool. When exposed in the air to a high temperature, it burns with a rich flame. It is insoluble in water and in alcohol, but soluble in naphtha and in the volatile oils. According to Dr Ure, it is composed of

Carbon, ...	90.
Hydrogen, ...	9.12
Oxygen, ...	0.88
	100 parts.

The oxygen, being in such small proportion, may be regarded as adventitious.

CHAP. III.—VEGETABLE ACIDS, MOST OF WHICH CONTAIN MORE OXYGEN THAN WOULD BE NECESSARY TO FORM WATER WITH THEIR HYDROGEN.

478. THE acids which exist ready formed in vegetables are the acetic, tartaric, citric, oxalic, benzoic, malic, gallic, and prussic acids. In the state in which we procure them they are combined with a considerable quantity of water: in stating their chemical composition this is omitted.

1. ACETIC ACID.

479. This substance, the pure matter of vinegar, does not often occur free in vegetables, but is generally in combination with potassa or lime. In the sap of some trees it is present in very minute portions. It is formed during acetous fermentation, and by the destructive distillation of wood. Formed in the latter way, it is called Pyroligneous Acid. Acetic acid is transparent and colourless, has a fragrant odour, and a strong sharp taste. It consists of, according to some chemists,

Carbon,	4 equivalents	24	or	48
Oxygen,	3	24	...	48
Hydrogen,	2	2	...	4
		50 parts.		100 parts.

Dr Prout, in his analysis of this acid, found that it contains three atoms of hydrogen, the oxygen and hy-

drogen being exactly in the proportion to form water. According to the other view, there is an excess of one atom of oxygen.

2. TARTARIC ACID.

480. This acid exists in vegetables, mostly in union with potassa, forming a supertartrate. It may be procured from the pulp of the Tamarind (*Tamarindus indica*), from the juice of the Grape (*Vitis vinifera*), and of the Mulberry (*Morus nigra*). It is also said to exist in considerable quantity in Sorrel (*Rumex acetosa*), and in Dandelion (*Leontodon Taraxacum*). It consists of

Carbon,	4 equivalents	24	or	36.5
Oxygen,	5	40	...	60.5
Hydrogen,	2	2	...	3.0
		66 parts.		100 parts.

3. CITRIC ACID.

481. This acid exists in the juice of Oranges and Lemons (*Citrus aurantium* and *C. medica*), of Cranberry and Whortleberry (*Vaccinium oxycoccos* and *V. vitis-idæa*), and Common Dog-rose (*Rosa canina*), and in several other fruits. It gives the juice of the Lime and Lemon their acidity. It consists of

Carbon,	4 equivalents	24	or	41.369
Oxygen,	4	32	...	54.831
Hydrogen,	2	2	...	3.8
		58 parts.		100 parts.

4. OXALIC ACID.

482. This acid contains no hydrogen, consisting of oxygen and carbon alone. It is found uncombined in the juice of the Chick Pea (*Cicer arietinum*); but is generally in combination with lime or potassa. It is found in union with the latter of these in Common Sorrel (*Rumex acetosa*), Wood Sorrel (*Oxalis acetosella*), and in the *Geranium acidum.* It has been found by M. Braconnot in several species of lichen, in combination with lime. It consists of

Carbon,	2 equivalents	12	or	33.34
Oxygen,	3	24	...	66.66
		36 parts.		100 parts.

5. BENZOIC ACID.

483. This acid is found in the balsams, as gum benzoin, storax, balsam of Tolu, &c. It has been found by M. Vogel in the flowers of the *Trifolium melilotus officinalis* (Common Yellow Melilot). The fragrance of the Sweet-scented Vernal Grass (*Anthoxanthum odoratum*) is said to depend upon the presence of benzoic acid. It consists of

Carbon,	15 equivalents	90	or	75
Oxygen,	3	24	...	20
Hydrogen,	6	6	...	5
		120 parts.		100 parts.

6. MALIC ACID.

484. This acid is found in Apples, Oranges, Barberries, Elderberries, Currants, Strawberries, Raspberries, &c. It has been found also in the House-Leek (*Sempervivum tectorum*), combined with lime, and in the berries of the Service Tree (*Sorbus aucuparia*). It consists of

Carbon,	4 equivalents	24	or	40.68
Oxygen,	4	32	...	54.24
Hydrogen,	3	3	...	5.08
		59 parts.		100 parts.

7. GALLIC ACID.

485. This is the acid which exists in the Gall-nuts, from which it takes its name. It is found in the bark of most trees of an astringent nature, as Oak (*Quercus Robur*), associated with tannin (493). It consists of

Carbon, ...	56.64
Oxygen, ...	38.36
Hydrogen . . .	5.00
	100 parts.

8. PRUSSIC OR HYDROCYANIC ACID.

486. This acid contains no oxygen, but consists of carbon, hydrogen, and nitrogen, in the following proportions :

Carbon,	2 equivalents	12	Cyanogen 26
Nitrogen,	1	14	
Hydrogen,	1	1	
		27 parts.	

487. It exists in the seed of the Peach, Cherry, Almond; and may be obtained by distilling Laurel leaves. The leaves of the *Prunus Lauro-cerasus* give a considerable quantity when distilled.

488. Besides these, there are many vegetable acids of less interest, such as the Succinic, obtained from Amber; the Suberic, from Cork; the Pectic, from the Carrot, &c. They are of little importance, and do not exist in any considerable quantity in the vegetable kingdom.

CHAP. IV.—VEGETABLE ALKALIS.

489. This is a newly discovered class of compounds, which contain nitrogen. In most plants which possess any marked property not depending on a volatile oil, as the Poppy, which has a narcotic effect, Peruvian Bark, which has a tonic effect, there has been found some peculiar principle, in combination with a vegetable acid, which principle is the cause of the virtues of the plant. This principle is called an Alkali, because it possesses the property of neutralizing acids. Morphia in opium, quinine in Peruvian bark, strychnine in the Nux-vomica, are the principles which give these plants their peculiar properties.

490. Besides these, the common alkalis, potassa and soda, are found in considerable quantities in vegetables. They are generally in combination with the acetic and carbonic acids; and in small quantities with the sulphuric and muriatic acids. Potassa may be obtained

from most plants by burning them, washing the ashes, filtering them, and evaporating to dryness. It is the most common alkali in vegetables. Soda is found in all plants growing in or very near the sea. There are only four of the earths found in vegetables, lime, magnesia, alumina, and silica (170). They are procured by incinerating the plant. The lime is usually in combination with carbonic acid; and small portions of the sulphate and phosphate of lime are sometimes present. Lime and silica exist in much larger quantity in the vegetable kingdom than magnesia and alumina; and of these two the former is the more abundant. These alkalis and earths form the ashes which remain after the burning of vegetables; and the insoluble matter of the ashes consists principally of the earths. The only other metallic oxides found in plants are those of iron and manganese. They are in very minute quantities. When the ashes are brownish-red, they contain iron; when purple or blackish, manganese. Herbs give more ashes than shrubs; and shrubs more than trees. The leaves of trees afford more than the branches, and the branches more than the trunk.

CHAP. V.—VEGETABLE COMPOUNDS WHICH DO NOT BELONG TO ANY OF THE PRECEDING CLASSES.

1. ALBUMEN.

491. This substance in the vegetable kingdom resembles, in composition and properties, that which ex-

ists in animal compounds. The purest albumen is the white of the egg. In the juice of the Papaw tree (*Carica papaya*) it exists in considerable quantity. When the juice is boiled, the albumen becomes coagulated, and is deposited. It has been found in large quantities in the fruit of the Ochra (*Hibiscus esculentus*). Care must be taken to distinguish between the chemical use of the term " Albumen," as applied to express a peculiar compound, and its botanical use as applied to a particular part of the seed. The part called the " Albumen " in Wheat contains little or no albumen (400).

2. GLUTEN.

492. This is a soft substance, much resembling dough. It is obtained from wheat-flour, by forming it into a paste, and washing it by exposing it to a small stream of water. The starch, mucilage, &c. are carried away by the water, and the gluten remains. It exists largely in the seeds of the Grasses. Wheat contains from one-fourth to one-fifth of gluten, and hence its superiority for the manufacture of bread. It is the gluten which produces the fermentation of the dough, by which the bread is raised, causing those interstices seen in every part. The yeast added is for the purpose of assisting and hastening the fermentation. It is found also in Acorns, Chestnuts, and many other seeds. It is very nutritious, and contains a considerable quantity of nitrogen.

3. TANNIN.

493. This is the substance which gives astringent vegetable substances their peculiar character. It is obtained in great quantities from the Gall-nut, in which it is mixed with water, gallic acid, and mucilage. It is obtained also from barks; the bark of the Oak yields it abundantly. It may be obtained also from bruised grape-seeds. It is soluble in water and in alcohol, but insoluble in ether. Catechu, prepared from the wood of the *Acacia catechu*, and Kino, from the *Eucalyptus resinifera*, contain large quantities of tannin. It has been analyzed by Berzelius, and found to consist of

Carbon, . . .	50·55
Oxygen, . . .	45
Hydrogen, . . .	4·45
	100 parts.

CHAP. VI.—GENERAL VIEW OF THE CHEMICAL COMPOSITION OF VEGETABLES.

494. There are altogether fifteen simple bodies entering into the composition of vegetables :—

Oxygen, Hydrogen, Carbon, } These three elements, with a small admixture of the following ingredients, make up the vegetable frame.

Nitrogen.

Sulphur (always in combination with oxygen forming *Sulphuric Acid*).

Phosphorus (in combination with oxygen in the form of *Phosphoric Acid*).

Chlorine (forming, with hydrogen, *Muriatic Acid*).

Potassium (in union with oxygen, in the state of *Potassa*).

Sodium (in union with oxygen, forming *Soda*).

Calcium (with oxygen, forming *Lime*).

Magnesium (with oxygen, forming *Magnesia*).

Silicum (with oxygen, forming *Silica*).

Aluminum (with oxygen, forming *Alumina*).

Iron (with oxygen, forming *Oxide of Iron*).

Manganese (with oxygen, forming *Oxide of Manganese*).

The last eight are metals, existing in vegetables in the state of earthy powders (oxides), mostly in union with some acid, and in very small quantities.

495. The sap is the watery fluid found in the alburnum; it varies much in different trees; it always contains a large quantity of water; and generally some sugar and mucilage, some acetate of potassa, carbonate of lime, acetate of lime, or acetate of alumina, and sometimes an uncombined acid. Sometimes tannin and gallic acid are present in the sap; but sugar and mucilage are the principal vegetable ingredients. Sir Humphry Davy, in his Elements of Agricultural Chemistry, has given an excellent account of the composition in general of the various parts of vegetables. From this part of his work I have made the following extracts.

496. " The tubes and hexagonal cells in the vascular system of plants are composed of woody fibre; and when they are not filled with fluid matter they contain

some of the solid materials which formed a constituent part of the fluids belonging to them."

"In the roots, trunk, and branches, the bark, alburnum, and heart-wood, the leaves and flowers; the great basis of the solid parts is woody fibre. It forms by far the greatest part of the heart-wood and bark; there is less in the alburnum, and still less in the leaves and flowers. The alburnum of the Birch contains so much sugar and mucilage, that it is sometimes used in the north of Europe as a substitute for bread. The leaves of the Cabbage, Broccoli, and Seacale, contain much mucilage, a little saccharine matter, and a little albumen. From 1000 parts of the leaves of common Cabbage I obtained 41 parts of mucilage, 24 of sugar, and 8 of albuminous matter."

"In bulbous roots, and sometimes in common roots, a large quantity of starch, albumen, and mucilage, are often found deposited in the vessels; and they are most abundant after the sap has ceased to flow; and afford a nourishment for the early shoots made in spring. The potato is the bulb that contains the largest quantity of soluble matter in its vessels and cells; and it is of most importance in its application as food. Potatoes in general afford from one-fifth to one-seventh of their weight of dry starch."

"The Turnip, Carrot, and Parsnip, afford principally saccharine, mucilaginous, and extractive matter. I obtained from 1000 parts of common Turnip, 7 parts of mucilage, 34 of saccharine matter, and nearly 1 part of albumen. 1000 parts of Carrot furnished 95 parts of sugar, 3 parts of mucilage, and ½ part of extract. 1000 parts of Parsnip afforded 90 parts of saccharine

matter and 9 parts of mucilage. The *Walcheren*, or *White Carrot*, gave, in 1000 parts, 98 parts of sugar 2 parts of mucilage, and 1 of extract."

"Fruits in the organization of their soft parts, approach to the nature of bulbs. They contain a certain quantity of nourishment laid up in their cells for the use of the embryon plant: mucilage, sugar, starch, are found in many of them, often combined with vegetable acids. Most of the fruit-trees common in Britain have been naturalized, on account of the saccharine matter they contain, which, united to the vegetable acids and mucilage, renders them at once agreeable to the taste and nutritive."

"Starch, or coagulated mucilage, forms the greatest part of the seeds and grains used for food; and they are generally combined with gluten, oil, or albuminous matter. In Corn, with gluten; in Peas and Beans, with albuminous matter; and in Rape-seed, Hemp-seed, Linseed, and the kernels of most nuts, with oils."

"I found 100 parts of good full-grained Wheat, sown in autumn, to afford,

Of Starch, . . .	77
Gluten, . . .	19

100 parts of wheat sown in spring,

Of Starch, . . .	70
Gluten, . . .	24

"In some experiments made on Barley, I obtained from 100 parts of full and fair Norfolk Barley,

Of Starch,	. . .	79
Gluten,	. . .	6
Husk,	. . .	8

The remaining 7 parts saccharine matter."

"I obtained from 100 parts of Rye, grown in Suffolk, 61 parts of starch, and 5 parts of gluten."

"100 parts of Oats from Sussex afforded me 59 parts of starch, 6 of gluten, and 2 of saccharine matter."

"1000 parts of Peas, grown in Norfolk, afforded me 501 parts of starch, 22 parts of saccharine matter, 35 parts of albuminous matter, and 16 parts of extract, which became insoluble during evaporation of the saccharine fluid."

"The different parts of flowers contain different substances: the pollen, or impregnating dust of the date, has been found by Fourcroy and Vauquelin to contain a matter analogous to gluten, and a soluble extract abounding in malic acid. Link found in the pollen of the Hazel-tree much tannin and gluten."

"It has been stated that the fragrance of flowers depends upon the volatile oils they contain; and these oils, by their constant evaporation, surround the flower with a kind of odorous atmosphere; which, at the same time that it entices larger insects, may probably preserve the parts of fructification from the ravages of smaller ones. Volatile oils, or odorous substances, seem particularly destructive to those minute insects and animalcules which feed on the substance of vegetables; thousands of Aphides may be usually seen on the stalk and leaves of the Rose; but none of them are ever observed in the flower."—"The woods that con-

tain aromatic oils are remarked for their indestructibility, and for their exemption from the attacks of insects: this is particularly the case with the Cedar, Rose-wood, and Cyprus."

"The petals of many flowers afford saccharine and mucilaginous matter. The White Lily yields mucilage abundantly; and the Orange Lily, a mixture of mucilage and sugar; the petals of the Convolvulus afford sugar, mucilage, and albuminous matter."

as in the animal kingdom, the species are grouped together by Nature in Classes or Families, differing from each other in several particulars, but in each of which families, all the species agree in some important and easily discernible characters, and, more or less, in their internal structure and properties. These classes frequently run into each other, and their diagnostic characters and limits are not always so well marked as could be wished. Still, however, they are sufficiently distinct for the purpose of a good natural arrangement. Such a method, if at all perfect, should not only serve the purpose of an artificial system, but enable us, in the case of a new and unknown plant, from the examination of a few of its characters, to have an idea of many of its other characters, its internal structure, and habits, and to predict what properties it is most likely to possess. A great variety of systems for the classification of plants have been proposed, some natural, some artificial, and some of a mixed nature. At present the systems most followed are, the Artificial or Sexual System of Linnæus, and the Natural Method of Jussieu.

501. Many of these natural families must have been observed by every one who has paid even the slightest attention to plants. No one ever mistook the Mosses for the Grasses, or the latter for the Ferns, or these for the Lily tribe. Accordingly, we find that there has always been some arrangement in use, however imperfect. The ancients spoke of Trees, Shrubs, and Herbs, and this division is in popular use at the present time. Then plants were considered with respect to their uses as food or as medicines, and subdivided

accordingly. Gradually, as our knowledge of plants increased, and the necessity for some arrangement became greater, they were classified as Grasses, Cruciferous Plants, Bulbous Plants, &c. This division, however, which is on excellent principles, the botanists of former times were unable to extend to all plants, from their very limited knowledge of vegetable anatomy. To this circumstance also we must attribute the number of artificial systems which were invented to supply the place of a natural method. Till the beginning of the sixteenth century, the systems in use were very superficial, and of little practical utility. About this time there were two methods proposed, one by Gesner, and the other by Cæsalpinus. Many modifications of these, and several new modes, were proposed by various botanists between that period and the end of the seventeenth century, when Tournefort advanced his celebrated system. This, however, did not long enjoy the public favour: the system of Linnæus, promulgated in 1734, soon acquired a reputation far beyond that of any of its predecessors, and has continued ever since to occupy a high place in the estimation of botanists. But this system, so long the exclusive idol of the botanist, has, in its turn, been compelled to divide its claims with another, first developed by Jussieu in 1789, and subsequently improved by De Candolle, Brown, Richard, and other eminent botanists of the present day.

502. Gesner and Cæsalpinus were the first who pointed out the necessity of taking the leading characters in classification from the flower and the fruit. This was a great step gained. These are the most

PART II.

SYSTEMATIC BOTANY.

497. After we have acquired a knowledge of the structure and functions of plants in general, we are able to proceed to the proper object of Botany—the study of individual plants.

498. The plants which we observe on the surface of the globe are, like the animal creation, divisible into groups, of which the individual plants are exactly similar to each other in appearance, in structure, &c. For instance, all the plants which are known by the name of "Common Red Poppy" are almost exactly alike; if we examine two specimens of Purple Foxglove (*Digitalis purpurea*), we shall find them almost exactly alike in every particular; one may be larger than the other, have more flower-buds developed, or have its petals of a richer hue, but in every essential point these two plants closely resemble each other; and they bear the same relation to one another as one animal does to another of the same kind or species. A group of plants, such as this, is called a *Species;* and as, from their nature, when we have made ourselves intimately acquainted with one specimen of a species

of plants, we know all the rest, the ultimate object of a botanist is to render himself familiar with the characters of the different species which we find on the surface of the earth.

499. As the number of these is too great, and their differences too great and too numerous, to admit of studying each species separately, it has been found necessary to arrange them in divisions and subdivisions, &c., each of which shall possess some well marked character common to all the plants that are included under it. This being done, from a few simple characters we shall be able to find out in a work of reference the name of any known plant which may be presented to us, and thus ascertain its history. This is the main object of what is called an *Artificial System* of Classification; so called, because it does not depend on the distinctions marked out, nor correspond with the system followed, by Nature. It generally depends on only one or two organs, and sometimes upon an accidental or comparatively unimportant character of the organ, and frequently combines under one class or order plants dissimilar to each other in almost every point except that single one for which they may be brought together, and separates others which are in many respects nearly related. An artificial system, from its simplicity, is extremely convenient, and, indeed, necessary, for beginners; but it should be regarded only as an introduction, because it does not communicate any information regarding the other characters, structure, or properties of the plant, and is of little or no use in the case of a new and unknown plant.

500. Now, it has been found that, in the vegetable

ties. The Systems of Linnæus and Jussieu do not differ about the arrangement of varieties or species—with respect to these they are both the same, always placing the same variety under the same species, and the same species under the same genus. It is in the arrangement of the genera that these two methods are at variance.

507. A species (498) includes so many plants of the same structure, form, and general appearance, and the seeds of which always produce plants similar to themselves. Difference in species is the only precise and constant distinction established by nature. The arrangement of species into genera is an artificial classification; the occurrence of varieties is not constant nor regular; but a species is a group of plants formed by nature distinct from all other kinds of plants. The distinctive characters of species are taken generally from the root, stem, or leaves. A variety of a species differs from it in some trifling character, such as colour of the flowers, size, pubescence of the leaves, &c. A genus consists of several species differing from each other by what are called the specific characters, taken from the leaves, &c., but agreeing together in the more important characters taken from the fructification. The following generic and specific characters of the genus Pyrus, and the species which it includes, will illustrate the distinction between genera and species.

PYRUS (PEAR, APPLE, AND SERVICE).

Generic Character.—Calyx superior, of five segments. Petals five. Styles two to five. Fruit fleshy (a pome, or apple), with five cartilaginous two-seeded cells.

Pyrus communis (Wild Pear-tree); leaves simple, ovate, serrated, peduncles corymbose, fruit turbinate.

Pyrus malus (Crab-apple); leaves ovate, acute, serrated, flowers in a sessile umbel, styles combined below, fruit globose.

Pyrus torminalis (Wild Service-tree); leaves ovate or cordate, lobed, and serrated, lower lobes spreading, peduncles corymbose.

Pyrus domestica (True Service-tree); leaves pinnated, downy beneath, leaflets serrated upwards, flowers panicled, fruit obovate.

Pyrus aucuparia (Quicken-tree, Mountain-ash, or Rowan-tree); leaves pinnated glabrous, leaflets serrated, flowers corymbose, fruit small globose.

*Pyrus pinnatifida** (Bastard Mountain-ash); leaves entire, pinnatifid and pinnated, white and downy beneath, flowers corymbose, fruit globose.

Pyrus aria (White Beam-tree); leaves ovate, cut and serrated, white and downy beneath, flowers corymbose, fruit globose.

508. The following description of the genus Rose, and the species Dog-Rose, will shew more precisely the meaning of the term " variety" in Systematic Botany.

ROSA, (ROSE.)

Generic Character.—Calyx urn-shaped, fleshy, contracted at the orifice, terminating in five segments. Petals

* Some of the *leaves* of this plant so nearly resemble the following" (*Pyrus aria*), " that I fear (and Professor Henslow is of the same opinion) it can only be considered a *variety*."—*Dr Hooker;* from whose British Flora the above characters of Pyrus, and the following of Rosa, are taken.

proper organs to be chosen for this purpose, as they are the most important parts of the plant, and the least subject to variation in structure and appearance; and upon these all the subsequent systems have been founded.

503. The method established by Tournefort was made to depend principally upon the presence or absence, form, and mode of division, of the corolla; and a few of his classes are very natural, and are still retained, as the Labiatæ, Cruciferæ, Papilionaceæ, Umbelliferæ, and one or two more. He first made a grand division of vegetables into Herbs and Trees. Herbs were divided into the Petalous (fourteen Classes), and the Apetalous (three Classes). The Petalous are divided into those with simple (eleven Classes) and those with compound flowers (three Classes). The Simple Petalous are divided according as they have monopetalous, polypetalous, regular, or irregular, corollas; and, finally, according to the form of the corolla. The trees are divided much in the same way.

504. The system of Linnæus was founded on the number of the stamens. This was made to determine the primary divisions or classes: the subdivisions or orders, in most cases, depend on the number of pistils. These two systems (of Tournefort and Linnæus) are artificial methods. When we are informed that a plant belongs to a particular class in the Linnæan System, we know only the number of the stamens—we neither know any of its other characters, nor can we have any idea of its properties. It resembles an alphabetical index to a description of plants, which, when we have got the name of a plant, informs us in what page we shall find

its history. In like manner, when we know one or two characters of a plant, we can find its place in the Linnean system, and thus, in any work containing a description of plants arranged according to this method, ascertain its history.

505. According to the method of Jussieu, plants are grouped together, not because they may agree in the structure or number of any single organ, but because, on taking all their different characters into consideration, they are found to bear a strong resemblance to each other: and we also find that, in general, the properties of plants are similar in those which are like in their external characters. For these reasons, it is generally called the Natural System. An acquaintance with it affords a broad, comprehensive, and scientific view of the vegetable creation; and it embodies much important information regarding the structure, physiology, and properties of plants, and their mutual relations. Though this is the system which it must always be the object of botanical science to perfect, and with which it is necessary for every student of botany to be intimately acquainted; as it has not been found possible to simplify it as much as could be desired, a knowledge of the Linnean System must also be acquired. From its comparative simplicity, it is very convenient for those commencing the study; and indeed, till within these few years, it alone was followed in this country.

506. Before proceeding to examine in detail the Natural and Artificial Systems, we must attend to the division of plants into *genera*, *species*, and *varieties*. A genus includes many species, and a species many varie-

five. Pericarps (or carpels) numerous, bristly, fixed to the inside of the calyx.

Rosa canina (Common Dog-rose); prickles uniform, hooked, leaves naked or slightly hairy, their disk eglandulose, calyx-segments fully pinnate deciduous, styles not united, shoots assurgent.

α. Leaflets naked, carinate; serratures simple.
  a. Green.
  b. Grey.

β. *Sarmentacea,* leaflets naked, carinate; serratures compound.
  a. Green.
  b. Grey.

γ. *Surculosa,* leaflets naked, flat; serratures simple.
  a. Green.
  b. Grey.

δ. *Dumetorum,* leaflets more or less hairy, flat.
  a. Hairy on both sides.
  b. Hairy beneath only.

ε. *Forsteri,* leaflets more or less hairy, not flat.
  a. Concave, green.
  b. Carinate, grey.
    1. Hairy beneath only.
    2. Hairy on both sides.

SECTION I.

THE NATURAL SYSTEM OF CLASSIFICATION.

509. As has been already mentioned, the parts of the flower and fruit are those which are best adapted for the construction of a scientific arrangement. The natural system is composed of from one to two hundred orders: that is, there are upwards of a hundred families of plants which differ from each other in some well marked and important particulars. But botanists do not content themselves with observing the natural arrangements of plants in families. They go a step farther, and endeavour to arrange these families in divisions, sections, classes, &c., founded upon some parts of importance in the structure of plants. And accordingly, when it is found that a family of plants is placed in a particular situation in our method, we have acquired a knowledge of some leading points in the structure of the plants in that family. These families themselves must be classified, as well as the plants which they contain, that we may be enabled by one or two characters to find them easily.

510. The first grand division is into those which have flowers, sexual organs, and a seed with an embryo, and those which are destitute of these organs. The first are the Phenogamia, called also Vasculares (25), Embryonatæ, or Cotyledoneæ: The second are

the Cryptogamia, called also Cellulares, Inembryonatæ, or Acotyledoneæ ; see par. 424.

CRYPTOGAMIA.

511. The orders in this division are few and easily remembered: they are often set down without any further arrangement, being only ten in number; see page 167.

PHENOGAMIA.

512. In this division there are a great number of different orders, which require to be arranged in sections or classes.

513. The Phenogamia or Cotyledoneæ are, in the first place, divided into two large sections: the Monocotyledoneæ (406), or Endogenæ (83); and Dicotyledoneæ (408), or Exogenæ (109). So far all botanists are agreed: after this, the further arrangements of the orders are different in the systems of different writers. I shall follow that of Jussieu, as it is the system most in use.

MONOCOTYLEDONEÆ.

514. The Monocotyledoneæ are, in Jussieu's method, divided into three classes, according to the mode of insertion of the stamens. This is a more permanent character than number, which is very liable to vary.

(1.) The *Monohypogyneæ*, in which the stamens are *hypogynous*, or inserted at the base of the ovary, which is here called *superior*.

(2.) The *Monoperigyneæ*, in which the stamens are *perigynous*, or inserted in the perianth or calyx around the ovary, which may be superior, inferior, or semi-inferior.

(3.) The *Monöepigyneæ*, in which the stamens are *epigynous*, or inserted above the ovary, which is here called *inferior*.

DICOTYLEDONEÆ.

515. The dicotyledonous orders are much more numerous, and require further subdivision. Accordingly, they are first arranged in three divisions.—The first embraces those which are destitute of petals, or *apetalous:* the next, those which have the petals united in one leaf, or are *monopetalous:* the next, those which have several distinct petals, or are *polypetalous.*

Apetalous Dicotyledons.

516. The dicotyledonous apetalous plants are subdivided, in Jussieu's arrangement, into three classes, according as the stamens are epigynous, perigynous, or hypogynous.—the Epistamineæ, Peristamineæ, and Hypostamineæ. Many of the apetalous plants have scaly organs resembling a floral envelope; these consist of bracteæ, or of a *single* floral envelope, called calyx: even where this organ is coloured, as in *Daphne mezereum*, it is considered as a calyx, if it be single, and the plant is called apetalous (263).

Monopetalous Dicotyledons.

517. The dicotyledonous monopetalous plants are divided into the *hypocorolleæ*, with hypogynous sta-

mens; *pericorolleæ*, with perigynous stamens; and the *epicorolleæ*, with epigynous stamens. The latter are divided into the Synanthereæ, with the anthers united; and the Chorisanthereæ, with the anthers distinct or free. It must be remembered that the insertion of the perianth always corresponds to that of the stamens; we never have epigynous stamens and a hypogynous perianth: the terms "epigynous" and "hypogynous" refer indifferently to the stamens and perianth.

Polypetalous Dicotyledons.

518. The dicotyledonous polypetalous plants are divided into the *epipetaleæ*, with epigynous stamens; the *hypopetaleæ*, with hypogynous stamens; and the *peripetaleæ*, with perigynous stamens.

519. The names of the classes are very characteristic. The three classes in the monocotyledonous division are marked by the prefixture *mono*. All the others (except the Cryptogamia) are in the dicotyledonous division. The first three classes in this division are apetalous; accordingly the terms *petal* or *corolla* are not mentioned in their names. In the next three classes the plants are monopetalous:—here, then, the term *petal*, which is generally used to express one of the parts of a polypetalous corolla, is not used. The term employed is *corolla*, which signifies the whole corolla, and may be properly applied to express an entire corolla. In the names of the last three classes, which are polypetalous, the term *petal* is used, signifying that the corolla here consists of several pieces or petals.

JUSSIEU'S NATURAL METHOD.

CRYPTOGAMIA (ACOTYLEDONEÆ)			Sexual organs absent or not apparent	CRYPTOGAMIA.
PHENOGAMIA (COTYLEDONEÆ). Sexual organs always present.	MONOCOTYLEDONEÆ (ENDOGENÆ.)		Stamens hypogynous	MONOHYPOGYNEÆ.
			perigynous	MONOPERIGYNEÆ.
			epigynous	MONOEPIGYNEÆ.
	DICOTYLEDONEÆ (EXOGENÆ.)	APETALEÆ*	epigynous	EPISTAMINEÆ.
			perigynous	PERISTAMINEÆ.
			hypogynous	HYPOSTAMINEÆ.
		MONOPETALEÆ	hypogynous	HYPOCOROLLEÆ.
			perigynous	PERICOROLLEÆ.
			epigynous	EPICOROLLEÆ.
		POLYPETALEÆ	epigynous	EPIPETALEÆ.
			hypogynous	HYPOPETALEÆ.
			perigynous	PERIPETALEÆ.
		Flowers constantly unisexual		DICLINEÆ*.

* In the following arrangement I have brought the orders in the last class (Diclineæ) to the subdivision Apetaleæ, and have dispensed with the arrangement into Epistamineæ, Peristamineæ, and Hypostamineæ, which cannot be applied with such propriety where the flowers are unisexual, and the perianth often altogether wanting.

TABLE

OF THE

NATURAL FAMILIES OF PLANTS.

Those Orders with the letter M *annexed contain Medicinal Plants.*

DIVISION I.—CRYPTOGAMIA.

SECTION I.—APHYLLEÆ.

Fungi, M ....Agaricus campestris, *Common Mushroom.*
Lichenes, M ....Cetraria Islandica, *Iceland Moss.*
Algæ, M...............Fucus vesiculosus, *Sea-ware.*

SECTION II.—PHYLLOIDEÆ.

I. MUSCOIDEÆ.

Characeæ,............Chara.
Hepaticæ,............Jungermannia.
Musci,..................Polytrichum commune.

II. FILICOIDEÆ.

Marsileaceæ, ...Pilularia globulifera, *Pillwort.*
Lycopodiaceæ,......Lycopodium clavatum, *Club-moss.*
Filices, M............Aspidium Filix-mas, *Male Shield Fern.*
Equisetaceæ,........Equisetum, *Horsetail.*

DIVISION II.—PHENOGAMIA.

SECTION I.—MONOCOTYLEDONEÆ.

I. MONOHYPOGYNEÆ.

NAYADEÆ, ...Zostera, *Grass-wrack.*
AROIDEÆ, M...........Acorus Calamus, *Sweet-flag.*
PIPERACEÆ, M........Piper nigrum, *Black Pepper.*
GRAMINEÆ, M.........Avena sativa, *Oat.*
CYPERACEÆ, ...Cyperus longus, *English Galingale.*

II. MONOPERIGYNEÆ.

PALMÆ, M.............Phœnix dactylifera, *Date Palm.*
JUNCEÆ, ...Juncus effusus, *Soft Rush.*
ALISMACEÆ, ...Alisma Plantago, *Greater Water Plantain.*
COLCHICACEÆ, M.....Colchicum autumnale, *Meadow Saffron.*
ASPARAGINEÆ, M....Smilax Sarsaparilla.
LILIACEÆ, M.........Scilla maritima, *Squill.*
BROMELIACEÆ, ...Bromelia Ananas, *Pine Apple.*

III. MONOEPIGYNEÆ.

DIOSCOREÆ, ...Dioscorea alata, *White dry Yam.*
NARCISSEÆ,............Galanthus nivalis, *Snow-drop.*
IRIDEÆ, M ....Crocus sativus, *Saffron Crocus.*
HÆMODORACEÆ,......Dilatris tinctoria.
MUSACEÆ, ...Musa Paradisiaca, *Plantain.*
SCITAMINEÆ, M......Amomum Zingiber, *Ginger.*
MARANTACEÆ, ...Maranta arundinacea, *Arrow-root.*
ORCHIDEÆ,............Orchis mascula, *Early Purple Orchis.*
HYDROCHARIDEÆ,...Stratiotes aloides, *Water Soldier.*

SECTION II.—DICOTYLEDONEÆ.

1. APETALEÆ.

ARISTOLOCHIÆ, M ...Asarum europæum, *Asarabacca.*
SANTALACEÆ, ...Santalum album, *Sanders-wood.*

CUPULIFERÆ, M.....Quercus Suber, *Cork-tree.*
JUGLANDEÆ,..........Juglans regia, *Wallnut.*
CONIFERÆ, M.........Pinus sylvestris, *Scotch Fir.*
CYCADEÆ,..............Cycas circinalis; yields *Sago.*
SALICINEÆ, M.........Populus tremula, *Aspen.*
BETULINEÆ,..........Betula alba, *Common Birch.*
MYRICEÆ,..............Myrica gale, *Dutch Myrtle.*
EUPHORBIACEÆ, M..Ricinus communis, *Castor-oil Plant.*
URTICEÆ, M..........Humulus lupulus, *Hop.*
MYRISTICEÆ, M......Myristica moschata, *Nutmeg-tree.*
CHENOPODEÆ,........Spinacia oleracea, *Spinach.*
POLYGONEÆ, M......Rheum palmatum, *Rhubarb.*
LAURINEÆ, M.........Laurus cinnamomum, *Cinnamon-tree.*
THYMELEÆ, M.......Daphne mezereum, *Spurge Laurel.*
AMARANTHACEÆ,....Amaranthus.
NYCTAGINEÆ,.........Mirabilis jalapa, *Marvel of Peru.*

II. MONOPETALEÆ.

1. *HYPOCOROLLEÆ.*

PLANTAGINEÆ, ...Plantago major, *Greater Plantain.*
PLUMBAGINEÆ, ...Statice Armeria, *Sea Gilliflower.*
PRIMULACEÆ, ...Primula veris, *Cowslip.*
GLOBULARIEÆ, ...Globularia, *Blue Daisy.*
OROBANCHEÆ, ...Orobanche major, *Greater Broom-rape.*
SCROPHULARINEÆ, M...Digitalis purpurea, *Foxglove.*
SOLANEÆ, M..............Hyoscyamus niger, *Common Henbane.*
ACANTHACEÆ, ...Acanthus mollis.
JASMINEÆ, M............Syringa vulgaris, *Lilac.*
VERBENACEÆ, ...Verbena officinalis, *Common Vervain.*
LABIATÆ, M.............Mentha Piperita, *Peppermint.*
BORAGINEÆ, M...... ..Symphytum officinale, *Common Comfrey.*
CONVOLVULACEÆ, M...Convolvulus Jalapa, *Jalap.*
BIGNONIACEÆ,...........Bignonia chica, *Trumpet Flower.*
GENTIANÆ, M...........Gentiana lutea, *Yellow Gentian.*
APOCYNEÆ, M...........Strychnos nux-vomica.
SAPOTEÆ,.................Achras Sapota.

2. *PERICOROLLEÆ.*

STYRACEÆ, M.........Styrax Benzoin.
ERICINEÆ, M.........Vaccinium oxycoccos, *Cranberry.*
CAMPANULACEÆ,.....Campanula, *Bell-flower.*

3. *EPICOROLLEÆ.*

COMPOSITÆ, M........Leontodon Taraxacum, *Dandelion.*
DIPSACEÆ, ...Scabiosa succisa, *Devil's-bit Scabious.*
VALERIANÆ, M......Valeriana officinalis, *Valerian.*
RUBIACEÆ, M.........Asperula odorata, *Sweet Woodruff.*
CINCHONACEÆ, M....Cinchona.
CAPRIFOLIACEÆ, M..Lonicera Periclymenum, *Woodbine.*
LORANTHEÆ, ...Viscum album, *Misseltoe.*

III. POLYPETALEÆ.

1. *EPIPETALEÆ.*

RHIZOPHOREÆ, ...Rhizophora, *Mangrove.*
UMBELLIFERÆ, M....Daucus Carota, *Carrot.*
ARALIACEÆ, ...Panax quinquefolia, *Ginseng.*

2. *HYPOPETALEÆ.*

RANUNCULACEÆ, M..Aconitum napellus, *Monkshood.*
MAGNOLIACEÆ, M...Wintera Aromatica, *Winter's-Bark tree.*
ANONACEÆ, ...Anona squamosa, *Custard Apple.*
BERBERIDEÆ, ...Berberis vulgaris, *Barberry.*
MENISPERMEÆ, M...Menispermum cocculus.
RUTACEÆ, M.........Guaiacum officinale.
GERANIACEÆ, M.....Oxalis acetosella, *Wood Sorrel.*
MALVACEÆ, M.......Althæa officinalis, *Marsh Mallow.*
BOMBACEÆ,............Bombax pentandrum, *Cotton-tree.*
BYTTNERIACEÆ,.....Theobroma cacao, *Chocolate Nut tree.*
TILIACEÆ, ...Tilia europæa, *Lime-tree.*
THEACEÆ,.............Thea sinensis, *Tea-tree.*
OLACINEÆ, ...Heisteria coccinea, *Partridge Wood tree.*
GUTTIFERÆ, M......Stalagmitis Gambogioides, *Gamboge-tree.*

HYPERICINEÆ, ...Hypericum perforatum, *St John's Wort.*
AURANTIACEÆ, M...Citrus aurantium, *Orange-tree.*
VINIFERÆ, M.........Vitis vinifera, *Vine.*
ACERINEÆ, ...Acer saccharinum, *Maple-tree.*
MELIACEÆ, M........Canella alba, *False Winter's Bark.*
SAPINDACEÆ, ...Sapindus saponaria, *Soap Apple.*
POLYGALEÆ, M......Krameria triandria, *Ratanhy.*
FUMARIACEÆ, ...Fumaria officinalis, *Common Fumitory.*
PAPAVERACEÆ, M...Papaver somniferum, *Opium Poppy.*
NYMPHŒACEÆ, ...Nymphæa alba, *White Water Lily.*
CRUCIFERÆ, M........Brassica oleracea, *Cabbage.*
CAPPARIDEÆ, ...Capparis spinosa, *Caper-bush.*
RESEDACEÆ, ...Reseda odorata, *Mignonette.*
CISTEÆ, ...Cistus helianthemum, *Rock Rose.*
DROSERACEÆ,..........Dionæa muscipula, *Venus' Fly-trap.*
VIOLARIÆ, M.........Viola tricolor, *Heart's-ease.*
CARYOPHYLLEÆ, M..Dianthus deltoides, *Maiden Pink.*
LINEÆ, M.............Linum usitatissimum, *Flax.*

3. *PERIPETALEÆ.*

PORTULACEÆ, ...Portulaca, *Purslane.*
SAXIFRAGEÆ, ...Saxifraga granulata, *White Saxifrage.*
CRASSULACEÆ,..........Sempervivum tectorum, *House Leek.*
NOPALEÆ,................Cactus opuntia, *Indian Fig.*
RIBESIEÆ,...............Ribes grossularia, *Gooseberry.*
CUCURBITACEÆ, M....Momordica elaterium.
ONAGRARIEÆ,..........Epilobium, *Willow Herb.*
MYRTACEÆ, M.........Myrtus pimenta, *Allspice-tree.*
SALICARIÆ, M..........Lythrum salicaria, *Loosestrife.*
TAMARISCINEÆ,........Tamarix.
ROSACEÆ, M............Pyrus malus, *Crab Apple.*
LEGUMINOSÆ, M......Pisum sativum, *Garden Pea.*
TEREBINTHACEÆ, M..Amyris gileadensis, *Balsam of Gilead-tree.*
RHAMNEÆ, M...........Rhamnus catharticus, *Purging Buckthorn.*
CELASTRINEÆ,.........Euonymus, *Spindle-tree.*
AQUIFOLIACEÆ,........Ilex aquifolium, *Holly.*

CHARACTERS, &c.

OF THE

NATURAL ORDERS OF PLANTS.

FIRST DIVISION,

CRYPTOGAMIA *.

Cryptogamic or Flowerless Plants.

Cryptogamia, Linn.—*Acotyledones*, Juss.—*Inembryonatæ*, *Exembryonatæ*, or *Ahrizæ*, Richard.—*Cellulares*, Decandolle.—*Agamæ*, Lamarck.

CHARACTERS.—Floral envelope and sexual organs absent or not discernible. Reproduced by means of

* I have preferred the term "Cryptogamia" (κρυπτω, to be hid, and γαμος, marriage), because it agrees better than any other with the present state of our knowledge in this department of Botany, and is more comprehensive. The term "Cellular" is objectionable, because the Ferns are provided with a distinct vascular system; and the appellation "Acotyledonous" implies the constant absence of cotyledons, organs analogous to which have been supposed to exist in Ferns; from which Agardh divided the Cryptogamic plants into the true Acotyledoneæ, as Algæ; and the Pseudo-Cotyledoneæ, as Ferns, &c. The term "Cryptogamia" signifies that the sexual organs of this class, if they have any, are not apparent; which is an undoubted and obvious fact. Some botanists have endeavoured to make out something resembling sexual organs in the Ferns and Mosses. These attempts, however, have not been successful; and we might almost be justified in using the word *agamæ*, signifying the total absence of sexual organs. It would seem that, in this instance, there has been an idea that Cryptogamic plants must have their sporules or seeds formed by means of a sexual apparatus, because this is the case with flowering plants. But since these two great divisions are so very

little bodies called *sporules*, mostly enclosed in cases called *thecæ*, and frequently irregularly dispersed about the plant. Seeds or sporules (*sporæ, gongylæ*) simple bodies, without radicle, gemmule, or cotyledon; germinating indifferently in any direction, and striking root from any part of their surface. All destitute of spiral vessels, and consisting chiefly of cellular tissue. The Fern tribe alone has vessels.

EXAMPLES. — Sea-weeds,— Mosses,— Mushrooms,— Ferns.

The Orders in this Division are ten, and may be arranged in the following manner *:—

I. APHYLLÆ, or leafless; consisting of cellular tissue alone, and having naked sporules, ...		Fungi. Lichenes. Algæ.
II. PHYLLOIDEÆ,— having leafy expansions, and sporules enclosed in a proper integument or case.	1. MUSCOIDEÆ, or Moss-tribe, consisting of cellular tissue alone.	Characeæ. Hepaticæ. Musci.
	2. FILICOIDEÆ, or Fern-tribe, having tubular vessels.	Marsileaceæ. Lycopodiaceæ. Filices. Equisetaceæ.

different in structure, functions, form, and appearance, why may they not also differ in the mode of forming their seed? If an analogy will be allowed, it may be observed, as M. Richard and Dr Hooker have pointed out, that there are in many of the higher orders of vegetables organs formed without sexual apparatus, capable of reproducing the plant, as the bulbils of the Orange, Lily, and Mountain Garlic, &c. And, indeed, it may be further observed, that flowering and flowerless plants (supposing the latter to be destitute of sexual organs) do not differ more in mode of reproduction than the Mammalia, and the Polypi and Infusoria, which appear to be utterly destitute of sexual organs, and are conceived in many cases to propagate their species by means of organs analogous to the bulbils of some vegetables.

* In this arrangement I have combined the methods of MM. Agardh and Brongniart.

SECTION I.

APHYLLÆ.

ACOTYLEDONEÆ, *Agardh.*

Characters.—Cryptogamic plants destitute of leaves and of vessels, and having naked sporules. No marked distinction or point of separation between root and stem; being irregular homogeneous masses of vegetable tissue.

Fungi; Lichenes; Algæ.

ORDER I.

FUNGI—MUSHROOMS.

Fungi, Linn. and Juss.—*Epiphytæ*, *Byssoideæ*, *Gastromyci*, *Fungi*, and part of *Hypoxyla* of Dr Greville.

Characters.—Growing on the ground, or parasitic on the trunks of trees, decayed wood, dead leaves, &c.; seldom aquatic, and rarely or never green. Substance fleshy, corky, coriaceous, gelatinous, or minutely filamentous (floccose). Frequently resembling a parasol in form; sometimes consisting of globular masses, or of irregular stem-like bodies (like branches of Coral); in their simplest state small filaments; but extremely variable in form. Sporules frequently lying loose in the cellular tissue, or enclosed in membranous or coriaceous coverings. They are of quick growth and very

short duration, and, when dried, do not revive by the application of moisture.

The *volva* or *wrapper* is the bag enveloping the young plant in many Fungi, and having a cup-like appearance when the stem or stipe has emerged from it. The conical part supported by the stipe in many of this order is the *cap* or *pileus*, from which, in some, project downwards the *gills*, thin perpendicular lamellæ, supporting the sporules. This, the part of fructification, is the *hymenium*, which at other times consists of tubes, pores, subulate processes, or a cellular head, &c. In many Fungi there is a circular membrane surrounding the top of the stipe; this is the *annulus* or *veil*. The sporules are sometimes contained in a seed-vessel, called *peridium;* the sporules and peridium, which is often like a hollow ball, forming the whole plant.

Examples.—Common Mushroom (*Agaricus campestris*); Agaric of the Oak (*Boletus fomentarius*); mould of cheese, &c. (*mucor*); *Uredo segetum*, which attacks Wheat crops and destroys the grain, converting it into a black powder, called brand, dust brand, smut, or burnt corn. Another Fungus, *Uredo caries*, also injures Corn, by filling the kernel with a fetid greasy powder, which, when the Corn is thrashed, affects the whole mass. The *Puccinia graminis* also attacks Corn, causing the disease called blight, mildew, or rust. The dry-rot in wood is caused by the *Merulius lacrymans* (*Boletus l.*), a species of Fungus. The Puff-ball or Devil's Snuff-box (*Lycoperdon*) is a Fungus, the bag containing the dust being the peridium, while the dust consists of innumerable small sporules.

They may be divided into two great sections: the

Angiocarpi, which bear seeds internally, the Fungus being closed on all sides; and the Gymnocarpi, which bear seeds externally, that is, not enclosed by the Fungus. The Angiocarpi are either hard externally, like Sphæria; fleshy and solid, like Tuber (Truffle); or membranaceous and coriaceous, filled with a fine dust (the sporules), like Puff-ball, Blue Mould (*Monilia glauca* or *Mucor g.*). This division contains no eatable Fungi except Truffle.

The Gymnocarpi bear their sporules imbedded in an appropriate membrane (the hymenium), are fleshy, and have generally a distinct stipes and pileus. The hymenium, in some, as Phallus, dissolves into a gelatinous mass; while in others it is more permanent, sometimes forming plates or gills, as in the Common Mushroom; in other cases forming tubes, as in Boletus. Almost all the eatable Fungi are among the Gymnocarpi.

M. Braconnot found in Fungi a peculiar principle, which he has termed *fungin*, resembling vegetable fibre in the inertness of its properties, but affording by distillation products which resemble those obtained from animal matters. He also obtained an acid (*fungic acid*), *adipocire*, *sugar*, an *oily matter*, and a substance resembling osmazome.

Economical Properties*.—In Great Britain, and in many parts of the Continent, Mushrooms are regarded as a delicate article of food, and in some places are much used by the poorer inhabitants. Some kinds are much used for making ketchup, and various kinds

* For an account of the characters, properties, &c. of the eatable Fungi, see a paper in the 4th volume of the Transactions of the Wernerian Society by Dr Greville.

ous nature, which he called *amanitine.* They may be placed among the *narcotico-acrid* poisons. In some parts of Russia, the *Amanita muscaria* is used as an intoxicating agent, being dried, made into a kind of bolus, and swallowed without being chewed. The following are the most dangerous of the Fungi:

Amanita muscaria (Agaricus muscarius)*.
.... venenosa (Agaricus bulbosus).
Agaricus annularius.
.... olearius.
.... urens.
.... necator.
.... pyrogalus.
.... stypticus.

ORDER II.

LICHENES.—LICHENS.

Part of the *Algæ* of Juss. and Linn.—*Lichenes,* and part of the *Hypoxyla,* De Cand. and Grev.

Characters.—Membranaceous or gelatinous masses of cellular tissue, often dry and horny: some are spread over the trees, rocks, or earth on which they grow, in an expansion, thin like a crust, granulated, lobed, having imbricated scales, or sometimes consisting of a powdery layer; some resemble shrubs or corallines in miniature, growing erect on the ground, or hanging from trees. This expansion is called a *frond, thallus,* or *universal receptacle,* and is of various colours in different

* Vauquelin found a portion of the hydrocyanate of potassa in this Fungus; and in it *amanitine* was found by M. Letellier.

Lichens. The sporules are imbedded in the substance of the thallus, or scattered on its surface, and are often included in organs called *apothecia*, *shields* (scutella), or *tubercles*.

Examples.—*Lepraria botryoides*, a thin powdery green crust, frequent in shady situations on trees, posts, rails, &c. *Cenomyce coccifera* (Lichen cocciferus), which resembles a wine-glass; *Graphis scripta*, which resembles written characters; *Parmelia parietina* (Lichen p.), of a bright yellow colour, with saucer-shaped apothecia, frequent on trees and walls; *Lecanora murorum* (Lichen m.), of an orange colour, frequent on rocks and stones.

Lichens are much used in dyeing, furnishing a red, purple, or crimson dye. *Lecanora tartarea* furnishes the *Cudbear* of dyers. *Archil* (Orchall), a valuable dye, is obtained from the *Rocella tinctoria*. *Litmus* is prepared from this lichen. *Lecanora perella* affords a purple or crimson dye, the *orseille de terre* of the French. These are the principal kinds, but there are many others which abound in colouring matter.

Economical Properties.—The Lichens contain a considerable quantity of starch and mucilage, which render them very nutritious. The *Tripe de Roche*, on which the Canadian hunters frequently subsist, is a Lichen, called Gynophora. The rein-deer, which are so useful to the Laplanders, feed on the *Cenomyce rangiferina*, or Rein-deer Moss. *Cetraria Islandica* (Lichen Islandicus or Iceland Moss) is consumed as food by the Icelanders, being reduced to powder and made into cakes, after being steeped in water to extract the bitter

of sauces. Many Fungi are of a very dangerous nature. The taste is perhaps the best mode of distinguishing injurious from wholesome Fungi. If they are at all bitter, astringent, or styptic, or otherwise disagreeable, of course they must be rejected ; and also when the flesh is soft, or watery, gelatinous, or leathery, and if they become blue or green when cut. They should be used when young, as, when matured, they are often insipid and tough. The hymenium is in general to be rejected when the pileus has expanded. In very young Fungi, however, it is not so dangerous. It is said that spices, more particularly salt and vinegar, render even poisonous Fungi wholesome. All Fungi employed as articles of diet in Russia, where perhaps they are more employed than in any other country, are salted before being eaten. M. Richard recommends that all Mushrooms, about the wholesomeness of which there may be any doubt, should be steeped in vinegar before being used. Owing to the very volatile nature of their acrid principle, cooking, as stewing, is advisable with most Fungi, and seems to render them all more easily digested. The following are the kinds of Fungi most in use :

Agaricus campestris (Common Mushroom) *.
.... procerus.
.... edulis (White Caps).
.... oreades (Scotch Bonnets)†.
.... violaceus (Bluets).
.... odorus.

* Vauquelin analyzed this Mushroom, and found in it adipocire, a thick or oily matter, albumen, sugar of Mushrooms, a matter of an animal nature resembling osmazome, soluble in alcohol and in water, a matter insoluble in alcohol, fungin, and acetate of potassa.

† This is the species most frequently forming the *fairy rings*.

Agaricus eburneus.
.... ulmarius.
.... deliciosus.
Tuber cibarium (Truffle).
Morchella esculenta (Morel).
Helvella esculenta.
Clavaria coralloides.
.... cinerea.
Merulius cantharellus.
Boletus edulis.
Amanita cæsarea or aurantiacea.

Medicinal Properties.—These are of little interest. *Boletus igniarius* (or *fomentarius*), called Female Agaric, Agaric of the Oak, Spunk, Touchwood, has been employed as a styptic, for the suppression of hemorrhage. It probably acts in the same manner as lint or sponge. It grows parasitic on the Oak. To render it fit for use, the epidermis and porous parts are removed, and the rest is beaten into a soft spongy state. Dipped in a solution of nitre, it forms *amadou* or *German tinder*. The *Boletus laricis* (B. purgans) is a powerful cathartic, but little used. M. Dufresnoy has recommended an electuary of *Agaricus acris* or of *A. deliciosus* in consumption.

Officinal Plant.—Boletus igniarius.

Poisonous Properties.—Many of the Fungi are poisonous, and some that are used as articles of diet occasionally acquire poisonous properties. M. Braconnot analyzed many of this family, and found in some a saccharine matter, an acrid resinous matter, a volatile principle of a similar character, and fungin. M. Letellier found in some a narcotic principle of a very poison-

EXAMPLES.—Bladder Fucus, Sea Ware, or Sea Wrack (*Fucus vesiculosus*); Dulse (*Fucus palmatus; Rhodomenia palmata*, Grev.; *Halymenia p.*, Hooker); Tangle (*Fucus digitatus; Laminaria digitata*, Hook. and Grev.); and all other Sea Weeds. The green slimy matter observed very distinctly on those parts of newly formed piers exposed to the action of the water,—on rocks in the sea,—on gravel-walks after rain,—attached to sticks and stones in ditches and lakes,—belong to the genera Linckia (*rivularia*), Nostoc, Palmella, &c. in this Order. Algæ, within the reach of every one's observation, vary in size, from the fine delicate capillary tufts of the Confervæ, found waving in rivulets and ditches, to the thick stout stalks of Sea-tangle (*Laminaria digitata*), found in great abundance on our shores. In many parts of the ocean the Algæ form immense submarine forests.

The Algæ may be arranged in four divisions: I. TREMELLINEÆ; II. CONFERVOIDEÆ; III. ULVOIDEÆ; IV. FUCOIDEÆ.

Many of the Algæ abound in a gelatinous matter, which affords a kind of glue or varnish. The *Chondrus crispus* furnishes size for the use of house-painters.

"In the manufacture of kelp, however, for the use of the glass-maker and the soap-boiler, it is that the Algæ take their place among the most useful vegetables. The species most used for this purpose are *Fucus vesiculosus* (Kelp-ware or Sea-ware); *F. nodosus* (Sea-whistles); *F. serratus* (Black Wrack or Prickly Tang); *Laminaria digitata* (*Fucus digitatus*, Sea-girdles, Tangle, Red Ware); *L. bulbosa* (*F. bulbosus*, Sea Furbelows); *Himanthalia lorea* (*F. loreus*, Sea-thongs,

Drew); and *Chorda filum* (*F. f.*, Sea Catgut, Sea Lace)." —"Where the plants did not grow naturally, attempts have been made, and not without success, to cultivate them, by covering the sandy bays with large stones. By this method a crop of Fuci has been obtained, as we are informed by Mr Neill, in about three years, the sea appearing to abound everywhere with the necessary seeds."—*Grev. Algæ Brit.*

Kelp contains a great quantity of an impure carbonate of soda. The sea-weeds are dried, and put into a pit or kelp-kiln made in the earth. They are then burned to ashes; the vegetable matter flies off; and the ashes unite into a hard bluish mass, which is the kelp. Barilla is a substance of the same nature, and formed in the same way, but richer and purer. It is imported from the Mediterranean.

Economical Properties.—The Algæ contain a large quantity of a nutritious gelatinous substance (mucilage and albumen, according to Richard), and, were it not for their saltness, would probably be much more employed as articles of food. Sir Humphry Davy (*Agricul. Chem.* p. 245) mentions, that from the Common Fucus, by boiling it in water, he obtained one-eighth of a gelatinous matter, which had characters similar to mucilage. "*Rhodomenia palmata* (*Fucus palmatus*), the Dulse of the Scots, Dillesk of the Irish, and Saccharine Fucus of the Icelanders, is consumed in considerable quantities throughout the maritime countries of the north of Europe, and in the Grecian Archipelago: *Iridea edulis* (*Fucus e.*, *Halymenia e.*, and 'Dulse' in the south-west of England), is still occasionally

and purgative principles which it contains. *Cetraria nivalis* and *Sticta pulmonacea* may be used for the same purpose.

MEDICINAL PROPERTIES.—*Cetraria Islandica* is a useful demulcent, and has been recommended in cases of emaciation, on account of its nutritious virtues; and also in catarrh, hæmoptysis, diarrhœa, and dysentery. *Peltidea aphthosa* (Lichen aphthosus), according to Linnæus, is used in Sweden to cure the aphthæ or thrush in children; it is purgative. Mr Lindley mentions *Parmelia parietina*, *Borrera furfuracea*, *Evernia prunastri*, and *Cenomyce pyxidata* and *C. coccifera*, as possessed of astringent and febrifuge qualities. "The medicinal properties of the Lichens," says De Candolle, in his Essay on the Medicinal Properties of Plants, "reside chiefly in those of a soft consistence, perhaps because they contain most mucilage. They all have more or less of a bitter taste; appear to be composed of mucilage, of a small quantity of resin, but chiefly of a substance of an animal nature analogous to gelatine: the most of them are demulcent, usefully employed in decoction in diseases of the lungs, and capable of supplying food for man, as by steeping or repeated boiling their bitterness may be removed."—*Essai*, p. 318–9.

Officinal Plants.

Lichen islandicus,
Rocella tinctoria.

ORDER III.

ALGÆ.—SEA WEEDS, &c.

Algæ, Juss.; he included in Algæ the Lichenes, now made a separate Order.—*Hydrophyta,* Rich.—*Algæ* and *Chætophoroideæ,* Grev.

CHARACTERS.—Mostly aquatic vegetables, growing in the sea or in fresh water, destitute of a root for absorbing nourishment, but often firmly fixed by a fibrous or callous base, called a *scutate root.* Substance gelatinous; thin, membranous, or pellucid; tough and horny; or even woody. *Fronds* sometimes arising directly from the root, and constituting the whole plant; at other times placed on a stem (stipes) more or less thick; composed of delicate capillary filaments often finer than the hair, of thin membranous bands varying in length and in breadth, or of a more solid cylindrical or strap-like substance; sometimes solid, at other times tubular; frequently divided by joints or articulations; and often inflated at particular parts, forming vesicles filled with air. *Sporules* imbedded in tubercles in the substance of the vegetable; in simple dilatations or projections arising from the frond; scattered on its surface; placed in the tube when the frond is tubular; surrounded by an open involucre; or in clusters on a common receptacle. Semitransparent, and of a brown, green, purple, or reddish colour. "After having been kept dry for a considerable length of time they will revive by immersion in water; but that portion of the plant only imbibes the fluid which is immersed in it." —*Hooker.*

used." "*Porphyra laciniata* (*Ulva laciniata* or *umbilicalis*, Sloke in Scotland), and *P. vulgaris* (*P. purpurea*, *Ulva umbilicalis* or *purpurea*), is stewed and brought to our tables as a luxury, under the name of 'laver;' and even the *Ulva latissima*, or Green laver, is not slighted in the absence of the *Porphyræ*." "*Laurentia pinnatifida* (*Fucus pinnatifidus*), distinguished for its pungency, and the young stalks and fronds of *Laminaria digitata* —the former called Pepper Dulse, the latter Tangle— were often eaten in Scotland." "When stripped of the thin part, the beautiful *Alaria esculenta* (*Laminaria e.*, *Fucus esculentus*, Bladder-locks, Honey-ware), forms a part of the simple fare of the poorer classes in Ireland, Scotland, Iceland, Denmark, and the Faroe Islands."—*Greville.*

"To go farther from home, we find the large *Laminaria potatorum* of Australia furnishing the aborigines with a proportion of their 'instruments, vessels and food.' On the authority of Bory de Saint Vincent, the *Durvillæa utilis*, and other Laminariæ, constitute an equally important resource to the poor on the west coast of South America. In Asia, several species of Gelidium are made use of to render more palatable the hot and biting condiments of the east."—*Greville.*

Medicinal Properties.—The *Gigartina helminthocorton* (*Fucus h.*), or Corsican Moss, is a native of the Mediterranean, and frequently employed on the Continent as a vermifuge. Sea-weeds are valuable in medicine as furnishing iodine, which is employed with so much advantage in cases of bronchocele (goitre, or enlargement of the thyroid gland), and for the removal

of other indolent tumours. The Algæ contain iodine in the state of a hydriodate of potash or soda. The *Fucus vesiculosus* and *saccharinus* contain considerable quantities of this substance; and M. Ecklond ascertained that *Laminaria buccinalis*, found at the Cape of Good Hope, contains more than any of the European Algæ; and, according to Sir Humphry Davy, the Algæ of France furnish more than those of this country.

Officinal Plant.—Fucus vesiculosus.

"Among these plants," says De Candolle, "I do not perceive one which is *poisonous*, or at all *suspected*." Richard makes the same observation.

SECTION II.

PHYLLOIDEÆ.

PSEUDO-COTYLEDONEÆ, *Agardh.*

Characters.—Cryptogamic plants, having leaves or a leafy expansion, sporules regularly placed on some particular part of the surface of the plant and enclosed in a proper integument, and a distinct root and stem.

1. Muscoideæ. 2. Filicoideæ.

MUSCOIDEÆ.

Destitute of Vascular Tissue.

4. Characeæ. 5. Hepaticæ. 6. Musci.

ORDER IV.

CHARACEÆ.

Part of *Naiades*, Juss.—Placed in *Monandria Monogynia* by Sir J. Smith.—Part of *Hydrocharideæ*, R. Brown.—*Characeæ*, Richard, Hooker, &c.

Characters.—Aquatic, submersed plants, with fibrous roots fixed in the mud. Stems slender, green, and tubular, sometimes pellucid, and sometimes brittle, having a layer of carbonate of lime beneath the epidermis; sometimes articulated. Branches tubular, in whorls at regular distances round the stem, and bearing the fructification, which is of two kinds: 1. Minute round *globules*, of a reddish or orange colour, containing fluid, and a mass of minute filaments, and composed externally of a number of triangular scales which separate and produce its dehiscence. 2. *Nucules*, or capsules, which are axillary, sessile, oval, solitary, spirally twisted or striated, invested by a pellucid membrane, divided obscurely at the summit into five segments or lobes, one-celled, and containing many minute bodies, supposed to be seeds or sporules. The short branches which accompany the nucule, surrounding it at its base, have been called *bracteas*.

Examples.—This order consists of one genus, Chara, and little is known regarding the nature of its reproductive organs. Some have considered the nucule as a pistil, and the globule as an anther. It is chiefly remarkable for the quantity of calcareous matter under

its epidermis. The nucules are often found fossil in chalk, and here called *Gyrogonites*.

ORDER V.

HEPATICÆ.

CHARACTERS.—This family resembles the Mosses (*Musci*), but is distinguished from them by having spiral filaments (*elateres*) mixed with the sporules, and by the absence of any operculum or lid closing the theca, and of the peristome or fringe which is found in the Mosses. The reproductive organs generally consist of capsules and anthers, the former of which dehisce by two or more longitudinal valves. When dried, they readily revive by the application of moisture. They are minute plants, having a sort of rachis or stem, from which sessile leaves arise (*foliose*), or spread out into a broad leafy expansion (*frondose*), and provided with roots.

EXAMPLES.—Jungermannia, Marchantia, Targionia, Sphærocarpus, Riccia, Anthoceros.

MEDICINAL PROPERTIES.—*Marchantia polymorpha* was considered by the ancients as a specific in liver complaints, from which circumstance the order takes its name.

ORDER VI.

MUSCI.—MOSSES.

CHARACTERS.—Minute plants, aquatic or terrestrial, having fibrous or tufted roots; erect or creeping stems, varying in length from a line to several feet, simple or branched, with minute leaves, always sessile and alternate, and often imbricated, *cauline* (belonging to the stem), or *perichætial* (surrounding the fructification, and constituting the *calyx* or *perichætium* of Linnæus). Reproductive organs consisting, 1. of a seed-vessel (*theca, capsule*, or *urn*), sessile or on a stalk (*seta*), enveloped, when young, in a membranous covering, divided transversely into two portions, of which the upper (*veil* or *calyptra*, like an extinguisher) remains for a while, and the lower forms a permanent sheath (*vaginula*). The seed-vessel is generally closed at the top (under the calyptra) by a deciduous circular lid (*operculum*). The mouth (*stoma*) of the theca is naked, surrounded externally by an elastic ring, or furnished with one or more circular fringes or rows of teeth (*peristomia*), four in number, or some power of four. Theca filled with sporules, surrounding a central axis (*columella*). 2. Of axillary oblong bodies (*anthers?*) concealed among the leaves, with short footstalks, "containing a number of spherical or oval particles, which are emitted on the application of water."—Lindley. After being dried they readily revive by the application of moisture.

The calyptra is *dimidiate* when there is a slit pass-

ing up one side; when entire at the base, or with several very short clefts, it is *mitriform*. A little swelling on one side of the base of the theca is called a *struma*; when the theca is prolonged downwards, the appearance is termed an *apophysis*, which is evident in the genus Splachnum.

In Andræa, Phascum, and Voitia, the operculum is persistent. In Andræa the theca dehisces by four valves.

Examples.—Polytrichum; Hypnum; Sphagnum, found in bogs, and called Bog-moss; Phascum (earth-moss); *P. cuspidatum* is common on moist and shady banks; *P. piliferum* is abundant on dry banks and sandy fields; *Tortula muralis* (*Bryum murale*) on walls and stones; *T. ruralis* (*Bryum rurale*) on roofs of houses, trees, and wall tops. *Funaria hygrometrica* is abundant on old walls and buildings, and on dry and barren soils. Mosses are abundant every where; on trees, house-tops, walls, rocks, in bogs, in rivers, on cow-dung which has been long exposed to the weather, and on the ground.

The thecæ are considered the seed-vessels; but the nature of the axillary bodies is not well known. Hedwig supposed that they were anthers; while Sprengel considered them as buds, and Palisot de Beauvois held the same opinion. The latter physiologist considers the theca as an hermaphrodite flower, the central columella being the pistil enclosing the seeds or sporules, while the surrounding granules are the pollen; while Hill regarded the granules as true ovules, and the teeth of the peristomium as stamens. The axillary bo-

dies cannot be anthers, because they can strike root and become new plants; and because the theca often arrives at maturity before the supposed stamens or anthers are developed, and even when they do not exist. The columella cannot be viewed as a pistil, for it is often a hard solid body; nor the teeth of the fringe as anthers, as they are absent in many mosses. It is most probable that these axillary bodies are buds, capable of reproducing the plant, somewhat resembling the bulbils of some Phenogamic plants.

Mosses are found in almost every part of the world, being plentiful even on rocks in Spitzbergen; but they are less numerous where the atmosphere is dry and the climate warm. They are frequent on the roots and trunks of trees, and are supposed to defend them against the cold of winter, the burning heat of the sun, and the effects of too much rain.

Medicinal Properties.—*Polytrichum commune* was at one time used as a sudorific, and some of the mosses have been supposed astringent. At present none are used in medicine.

FILICOIDEÆ.

Possess a Vascular System.

MARSILEACEÆ, LYCOPODIACEÆ, FILICES, EQUISETACEÆ.

ORDER VII.

MARSILEACEÆ.

Included in the *Filices*, Linn. and Juss.—*Rhizospermeæ*, De Candolle.

CHARACTERS.—Small plants, more or less aquatic, sometimes floating, frequently having a creeping stem; fructification situated at the bases of the leaves, near the root, and consisting of coriaceous or membranous involucres not opening, containing globular membranous sacs, some of which (anthers ?) enclose loose grains, and others (capsules) seeds or sporules, sometimes intermixed with minute granules.

EXAMPLES.—Marsilea ; Isöetes (*Quillwort*); *Pilularia globulifera* (Pill-wort or Pepper-grass). In Isöetes the fructification is quite concealed, and contained within the very base of the leaf or frond, which only betrays its contents by being somewhat swollen at that part.

This singular family may be distinguished by the sporules being enclosed in thecæ contained in close involucres, and by the situation of the involucre at or near the root, from which De Candolle gave them the name Rhizospermeæ.

ORDER VIII.

LYCOPODIACEÆ.—CLUB-MOSSES.

Included in the *Musci*, Linn.; and in the *Filices*, Juss.

Characters.—Moss-like plants, with fibrous roots, simple or branched stems often creeping, numerous undivided small leaves, and the fructification axillary (at the inner base of a leaf) or in spikes, consisting of small capsules or thecæ (*conceptacles* and *coques*), opening by two or three valves, some containing a mass of minute pulverulent granules, others containing larger corpuscules or sporules, both kinds being sometimes found on the same plant.

Examples.—Lycopodium; *L. clavatum* (Common Club-moss) is plentiful on alpine moors and heaths. It is generally believed that plants of this family attained a great size in former times, and that the remains of many of them occur along with Ferns in the Coal formations.

The capsules of the Lycopodiums contain a yellow powder, called Vegetable Sulphur; it is very inflammable, and is used for fire-works. M. Pelletier found it to contain wax, sugar, and alum. Some of this family have been used for fixing fugitive colours in dyeing.

Medicinal Properties.—"The decoction of the herb of the *Lycopodium clavatum*, and especially of *L. Selago*, excites vomiting."—*De Candolle*, Essai, p. 312.

ORDER IX.

FILICES.—FERNS.

CHARACTERS. — Herbaceous plants, perennial, having generally a subterraneous candex (*rhizoma*), sometimes a creeping one; and, in tropical climes, a trunk above ground, resembling that of the Palms, having a hard fibrous coating formed of the persistent bases of the leaves. Leaves, or fronds, coming off from the main stem in the manner of leaves, simple, or variously divided, frequently pinnatifid, and rolled inwards at the point when beginning to grow. Reproductive organs, sometimes in spikes, generally on the back of the leaf (in which case the Fern is called *dorsiferous*). In the latter situation the groups of capsules or thecæ are called *sori*. The sori are often covered by a membranaceous integument, formed of the raised cuticle, and called *indusium* or involucre. The thecæ are sessile, or raised on a sort of pedicel (*pedicellate*), which is generally continued round them, constituting an elastic ring, by the action of which the dehiscence of the thecæ is produced.

EXAMPLES. — Polypodium; *P. dryopteris* (tender three-branched Polypody); *Aspidium Filix-mas* (Male Shield Fern) is a very beautiful specimen, and very common. They have been divided into five sections, the Polypodiaceæ, Gleichenieæ, Osmundaceæ, Marattiaceæ, and Ophioglosseæ. They are frequently found fossil in coal formations, and exist in most parts of the

world. In tropical climes, as in South America, they frequently assume the form and size of trees.

The Ferns, when burnt, afford a considerable quantity of potash, and have been used for the manufacture of glass.

Economical Properties.—Many of the Ferns possess a considerable quantity of starch or of mucilage in their roots, and are used as articles of food in some countries. *Pteris aquilina* (Common Brake). *P. esculenta*, *Nephrodium esculentum*, *Diplazium esculentum*, *Cyathea medullaris*, and *Angiopteris evecta* are said to be nutritious.

Medicinal Properties.—The leaves of *Adianthum pedatum*, *A. capillus veneris* (Maiden-hair), and several other species, are employed indiscriminately under the name of Capillaires, being expectorant and demulcent. They contain a thick mucilage, somewhat astringent, with a weak aroma. *Polypodium calaguala* is used in Peru as an astringent diaphoretic. *Aspidium Filix-mas* (Male-shield Fern) has a place in our Pharmacopœias as an anthelmintic, particularly for Tænia. The internal part of the root is the officinal part.

Officinal Plant.

Aspidium Filix-mas.

ORDER X.

EQUISETACEÆ.—HORSE-TAILS.

Included in the *Filices* of Linnæus and Jussieu.

CHARACTERS.—Herbaceous perennial plants, with hollow striated stems lined with silex under the cuticle, and articulated, each articulation being surrounded by a sheath, toothed, or cleft longitudinally into a number of pieces. Often branched, the branches arising in whorls from the articulation. Fructification forming an oblong spike at the extremity of the stem. Spike covered with peltate scales, from the under surface of which 4–7 wedge-shaped one-valved thecæ, bursting longitudinally, project inwards. The thecæ contain sporules, surrounded by minute granules, and having at their base four elastic filaments, swelled at the apex or extremity, twisted spirally round the sporule when moist, but unrolled and expanded when dry.

They may easily be distinguished by the tubular toothed sheath at each articulation of the stem, the terminal spike or cone of fructification, the four elastic filaments surrounding each sporule, and, if branched, by the branches being in whorls at the articulations, and sheathed like the stem.

EXAMPLES.—This family consists of only one genus, Equisetum, or Horse-tail. *E. arvense* (Corn Horse-tail) is very common. *E. fluviatile* (Great Water Horse-tail) is frequent in muddy lakes, sides of rivers,

and pools, and is the largest of the British species, being three or four feet high. *E. sylvaticum* (Branched Wood Horse-tail) is an elegant species.

Hedwig considers the sporule as a hermaphrodite flower, the central globular body being the pistil, while the surrounding filaments, he imagined, were stamens. M. Brongniart considers the swollen filaments as grains of pollen.

The Equisetaceæ are remarkable chiefly for containing under the cuticle a considerable quantity of siliceous earth. " The *Equisetum hyemale* contains more silex beneath its delicate epidermis than any other, and is, consequently, most employed in polishing hard wood, ivory, and even brass. The silex is so abundant, that the vegetable matter may be destroyed, and the form retained, as was done by Mr Sivright."—*Greville.*

The *Equisetum hyemale* is largely imported from Holland, for the purpose of polishing ivory, brass, &c., under the name of Dutch Rushes.

SECOND DIVISION.

PHAENOGAMIA.

Phænogamic or Flowering Plants.

Cotyledones, Juss.—*Vasculares*, De Cand.—*Embryonatæ*, Rich. —First twenty-three Classes of Linnæus.—*Phanerogamia*, or *Phænogamia*, &c.

Characters.—Sexual organs always present; in most cases surrounded by a floral envelope. Reproduced by means of seeds, having distinct coverings, cotyledons, and a radicle and gemmule. Growth in germination taking place only from the radicle and gemmule. All provided with vessels, and almost all having spirals.

Examples.—Rose, Lily, Grass, Corn, Poppy, Elm, Oak.

This very large assemblage of Plants has been divided into two sections, according to the structure of the embryo: 1. *The Monocotyledonous*; 2. *The Dicotyledonous*.

SECTION I.

MONOCOTYLEDONEÆ.

Exogenæ, De Cand. — *Endorhizæ*, Rich. — *Monocotyledones*, Juss., and most authors.

Characters.—*Embryo* with one cotyledon; or, if there are two, the additional one is smaller and less perfect than, and alternate with, the other. *Gemmule* usually enclosed in the substance of the embryo, which it bursts laterally at germination. *Radicle* also enclosed by the embryo, the inferior extremity of which is pierced by, and forms a sheath for, the radicle. *Perianth* often single or simple, and its parts generally three in number, or a multiple of three. *Leaves* frequently alternate and sheathing, and sessile or not distinctly articulated with the stem; and having parallel veins or nerves little branched. (See Frontispiece, Fig. 3.) *Stem* consisting of cellular tissue, through which bundles of vessels are irregularly scattered; without any division into pith, wood, and bark; and growing by the descent of new matter into the central part. (See Frontispiece, Fig. 1.)

Examples.—Palms, Lilies, Grasses, Orchis, Tulip, Onion.

The Monocotyledoneæ are called *Endogenæ* from their mode of growth (82-3), and *Endorhizæ* from the radicle being enclosed in a sheath (416).

The monocotyledoneæ are divided into three classes, according as the stamens are hypogynous, perigynous, or epigynous (302–4.)

MONOHYPOGYNEÆ.

Monocotyledonous plants, with hypogynous stamens, and the ovary of course superior.

11. Nayadeæ. 13. Piperaceæ. 15. Cyperaceæ.
12. Aroideæ. 14. Gramineæ.

ORDER XI.

NAYADEÆ.

This is a family of little interest. It contains Ruppia, Potamogeton (*Pondweed*), Zannichellia (*Horned Pondweed*), Zostera (*Grass-wrack*), and Nayas.

ORDER XII.

AROIDEÆ.

Characters. — Perennial herbs, or under-shrubs; often stemless. Root often tuberose or fleshy. Leaves sheathing. Inflorescence a spadix, generally enclosed in a large highly developed spatha. Hermaphrodite, or unisexual and monœcious. Perianth absent, or a scaly calyx of four or six divisions. Stamens short. Anthers turned outwards. Ovary 1- (occasionally 3-) celled; many-seeded. Stigma sessile, or with a short

celled, one-seeded, with a sessile stigma; pericarp fleshy (a berry), indehiscent, one-celled, one-seeded, the seed erect.

EXAMPLES.—This family consists of two genera, Piper, which is shrubby, and has three stamens; and Piperomia, which is herbaceous, and has only two stamens *.

They are found only in tropical climes, as South America, the East Indies, and the islands of Java, Borneo, and Sumatra, where they are extensively cultivated.

ECONOMICAL PROPERTIES.—The use of Common Pepper as a condiment is well known: this is the berry of the *Piper nigrum.* The entire berry, when dry, forms what is called Black Pepper: White Pepper is the internal part or seed of the same berry, the outer coat having been removed. The stimulant aromatic property is not confined to the berry; it is found in the other parts of the plant. M. Pelletier has found in *P. nigrum* a crystalline substance of a peculiar nature, which he has called *Piperin.*

The leaf of *Piper betel* is chewed in India as a luxury, along with the nut of the *Areca catechu,* a Palm, called Betel Nut, and a little lime: the composition is called *Betel,* and is much esteemed.

MEDICINAL PROPERTIES.—*Piper nigrum* is stimulant and carminative. *Piper longum* is used in several

* In these characters, I have followed Richard's account in his *Histoire Naturelle Medicale.* Many botanists describe Piper as having only two stamens, placing it in Diandria Trigynia. Mr Lindley places Piperaceæ among Dicotyledons.

aromatic preparations. The berry of *Piper cubeba* furnishes the cubebs of the shops, a well known purgative and diuretic, and used chiefly in cases of inflamed urethra. According to Vauquelin, cubebs contain a volatile oil, and a resin resembling copaiba balsam. They are used in the form of powder and tincture.

Officinal Plants.

Piper nigrum.
Piper longum.
Piper cubeba.

There are no poisonous plants among the Piperaceæ.

ORDER XIV.

GRAMINEÆ.—THE GRASSES.

Characters. — Herbaceous annual or perennial plants; roots fibrous, sometimes bulbous; stem a cylindrical culm, generally fistulous, and with knots from which alternate sheathing leaves arise; a transverse partition at the knots; leaves arising as sheaths, long and narrow, and having a small collar (ligula) at their union with the sheath, which is slit in the whole length; inflorescence a spike, spikelet, or panicle; flowers mostly hermaphrodite, occasionally monœcious or polygamous. At the base of the sexual organs are floral coverings or imbricated bracteæ, called Glumes and Paleæ. The most external are *glumes**, two in number, alter-

* The *calyx* of Linnæus and Smith (the separate pieces being called Valves); called Glumes, and considered bracteæ, by Brown and Lindley (220–1).

style. Pericarp indehiscent; a berry, or, more rarely, a capsule; sometimes one-seeded by abortion.

EXAMPLES.—Wake-Robin or Cuckoo-pint (*Arum maculatum*), Duckweed (*Lemna*).

This family has been divided into three sections:

I. The true Aroideæ, which have unisexual naked flowers, and the fruit a berry. Arum, Dumb-cane (*Caladium*), African-arum (*Calla*).

II. The Orontiaceæ, with hermaphrodite flowers, and a scaly calyx. Sweet Flag (*Acorus*), Dracontium, Pothos, Orontium, &c.

III. The Pistiaceæ, Floating plants, with a two-flowered spadix, naked flowers, and a capsular pericarp. Pistia, Lemna. This has been made a separate order by some botanists.

ECONOMICAL PROPERTIES.—The fleshy roots of many of this family contain a considerable quantity of an amylaceous substance, or starch, which, by maceration or roasting, is obtained free from the acrid principle which characterises the order, and is very nutritious. The *Arum maculatum*, treated in this way, furnishes a sort of substitute for bread-flour, known by the name of *Portland Sago*, and much used in Weymouth and in Portland Island. *A. esculentum*, *A. mucronatum*, *A. violaceum*, *A. colocasia*, *Calla palustris*, and some others, may be used in the same way.

MEDICINAL PROPERTIES.—There is an acrid stimulating principle found in this family, which renders

many of them aromatic, stomachic, or purgative; but it is very volatile and fugacious. The root of *Acorus Calamus*, or *Calamus aromaticus* (Sweet Flag), is an agreeable aromatic. The aromatic principle is a volatile oil. The tuberous root of Wake-Robin (*Arum maculatum*) is purgative: this property resides in the acrid milky juice of the fresh root. The fresh leaves of *Dracontium pertusum*, laid upon the skin, excite rubefaction or vesicles.—*De Cand.* Essai, p. 279. The roots and seeds of the Skunk Cabbage (*Symplocarpus fœtida*) are used as expectorants in North America.

Officinal Plants.

Arum maculatum.
Acorus Calamus.

Poisonous Properties.—The acrid principle is so powerful in some of this family as to render them dangerous. The Dumb-cane (*Caladium seguinum*), when chewed for a short time, or even bit, swells the tongue to an enormous degree, and often deprives the individual of speech for a while.

ORDER XIII.

PIPERACEÆ.

Included in the *Urticeæ* of Jussieu.

Characters.—Shrubs or herbs; leaves alternate, sometimes opposite; flowers in cylindrical spikes, hermaphrodite, naked, generally sessile; stamens 3 (Pepe-romia has only 2), slightly adhering to the ovary, and accompanied by some irregular scales; ovary one-

flour, much used for bread in some countries. The seeds of the Floating Fescue (*Festuca fluitans*) are sweetish, and are sometimes eaten in Poland. In Iceland and in Greenland the seeds of the Sea-lyme-Grass (*Elymus arenarius*) are made into bread. The small round seeds of Italian Millet (*Panicum Italicum*) are much valued by the native Indians, who make cakes of it, and also a kind of porridge. They use *Cynosurus coracanus* in the same way; it is called *Natchenny* by the Europeans.—*Ainslie.* Rice (*Oryza sativa*) and Indian Corn (*Zea mays*) contain little or no gluten: it is to the large proportion of gluten which it contains that Wheat owes its superiority to other kinds of grain. The seeds of the Grasses are also important from the facility with which they can be made to ferment and furnish alcohol, the basis of all our malt liquors. Arrack, the Whisky of the Indians, is obtained from Rice; and another kind of spirit, which bears the same name, is prepared from the fermented juice of the Sugar Cane. The culms of many of the Grasses contain a considerable quantity of sugar, particularly the *Saccharum officinarum*, from which the sugar of commerce is obtained. De Candolle mentions that the *Holcus saccharatus* has been cultivated with success in Italy for the sugar it contains. The *Saccharum sinense* is the species from which the Chinese procure their sugar: it yields sugar of a much richer quality than the Indian Cane, and continues to produce even to the third year, while the other must be renewed yearly.—*Ainslie*, vol. i. p. 409.

Thus man derives his main support from the Grasses,

living chiefly on their seeds, and on animals which derive their substance from them.

Medicinal Properties.—The Grasses present little of interest in a medicinal point of view. The roots and stems are more or less sweet, and of a demulcent nature, and also the seeds in decoction. The Ergot of Rye is of great use to the medical practitioner on account of its stimulant action on the uterus. This property, however, does not belong to the seed in its natural state, but in a state of disease from the presence of a fungus (*Sclerotium clavus*, De Candolle), or, as some suppose, from the ravages of an insect. The disease has been called Ergot, and consists in the pickle being changed to a long blackish body, somewhat like a spur; hence the name "Spurred Rye." The disease attacks Rye chiefly in damp situations, and is very frequent in some parts of France. Couch Grass (*Triticum repens*) is said to have a diuretic virtue in its roots: and the same property is found in the roots of *Arundo donax* and *A. phragmites.* Several species of *Andropogon* are said to be aromatic and tonic, as *A. schœnanthus*, *A. citratum*, and *A. nardus.* Rice (*Oryza sativa*) has been reckoned a good demulcent.

Officinal Plants.

Avena sativa.
Triticum hybernum.
Hordeum distichum.
Saccharum officinarum.

nate, and often unequal: sometimes one is absent. The next are *paleæ* *, also two in number; see Fig. 11, par. 219. Stamens generally 3, occasionally fewer, but seldom more; filaments capillary; ovary surmounted by two styles, terminated by glandular feathery stigmas, 1-celled, 1-seeded. At its base there are frequently two little *scales*, called also the *glumella* or *nectary*; pericarp a caryopsis closely adhering to the seed; embryo at one side of the base of a farinaceous albumen.

EXAMPLES.—This very natural family is one of the most extensive and important in the vegetable kingdom. It consists of all those vegetables called *Grasses*, as Wheat (*Triticum hybernum*), Oat (*Avena sativa*), Barley (*Hordeum distichum*). Reed (*Arundo*), Meadow-Grass (*Poa*), Fox-tail Grass (*Alopecurus*), Rice (*Oryza*), Indian Corn (*Zea mais*), Sugar Cane (*Saccharum officinarum*).

This family much resembles the Cyperaceæ. The following are the marks of distinction. The Cyperaceæ have a solid and frequently angular stem, no transverse partition (diaphragm) at the joints, an entire sheath, a single bractea or scale bearing the flower in its axilla, and generally three stigmas. The Gramineæ have a hollow or fistulous and round stem, a diaphragm at the joints, the sheath cleft, two pairs of scales to each flower, and two styles.

The Gramineæ contain a considerable quantity of silex in their culms, and hence are sometimes used for polishing brass, marble, &c.

* The corolla of Linnæus and Smith, perianth of Brown, glume of Richard.

Economical Properties.—The uses and importance of this family of plants as food both to man and the lower animals are well known. The leaves of the Meadow Fox-tail Grass (*Alopecurus pratensis*); Roughish, Smooth-stalked, and Annual Meadow-Grass (*Poa trivialis*, *P. pratensis*, and *P. annua*), are excellent pasture for cattle. Perennial Darnel or Rye-grass (*Lolium perenne*), is often employed for pasture and hay along with clover. Crested Dog's-tail-Grass (*Cynosurus cristatus*), Sheeps' and Hard Fescue-Grass (*Festuca ovina* and *F. duriuscula*), and some species of Cat's-tail-Grass (*Phleum*), also make excellent pasture. Sweet-scented Vernal-Grass (*Anthoxanthum odoratum*) gives new made hay its fragrance (483). In India Linear-bent-Grass (*Agrostis linearis*, *Cynodon dactylon*, or Dog's-tooth-Grass), is considered as the sweetest and most nutritive food for cattle.—*Ainslie's Materia Indica*, vol. ii. p. 28. At page 59 of the same volume, Dr Ainslie mentions that the fresh leaves of the Sweet Rush or Lemon-Grass (*Andropogon schœnanthus*) are sometimes used by the English in India as a substitute for tea; and that the white succulent centre of the leaf-bearing culms is often put into curries to give them an agreeable flavour. The most important part of the Grasses to man is the seed. This part contains a large quantity of starch (459) and gluten (492), and is very nutritious. Hence the extensive cultivation of Wheat, Oats, Barley, Indian Corn or Maize, Rice, &c. These kinds are preferred, as M. De Candolle observes, not so much because they are better than the seeds of other Grasses, but because they are larger. The seed of the Rye (*Secale cereale*) furnishes an agreeable kind of

Poisonous Properties.—There is only one plant of a poisonous quality in this family, the Bearded Darnel (*Lolium temulentum*), the seeds of which are of a deleterious nature. It seems to be one of the narcotico-acrid poisons. The Spurred Rye is also of a poisonous nature. It brings on giddiness, convulsions, and gangrene of the extremities. It is sometimes accidentally mixed with the grain in rye-bread, and has been known to cause a sort of epidemic in particular districts on the Continent where this kind of bread is much in use. Indian Corn is subject to the same disease as Rye, the ergot, and in this diseased state is called *Mays peladero*.

ORDER XV.

CYPERACEÆ.

Characters.—Herbaceous plants generally growing in moist places; roots fibrous; stem a cylindrical or triangular culm, often without joints, solid, and with no diaphragm at the joints; leaves sheathing; sheaths not slit; inflorescence a spike or spikelet; flowers unisexual or hermaphrodite; sexual organs generally in the axilla of a single bractea (glume); bracteas imbricated; stamens generally 3; ovary 1-celled, 1-seeded, surmounted by a single generally trifid style (sometimes bifid), surrounded at the base by minute scales or bristles (setæ); ovule erect; pericarp an achenium.

Examples.—Sedge or Sea Carex (*Carex arenaria*),

which has long and creeping roots, and is useful in binding a loose soil; Sweet Cyperus or English Galingale (*Cyperus longus*); Cyperus papyrus, from which the Papyrus of the ancients was made; Club-rush or Bull-rush (*Scirpus lacustris*), much used for mats, chair-bottoms, &c.; Twig-rush (*Cladium*), which has two stamens and two stigmas.

Economical Properties.—Many of this family contain a considerable quantity of mucilage in their roots. They are generally insipid and inodorous. The tubers of the *Cyperus esculentus* contain a great deal of starch, and a saccharine mucilaginous substance, and are eaten in Egypt, Spain, and Italy. Scaly-stalked Spikerush, or Deer's Hair (*Eleocharis cæspitosa*, or *Scirpus cæspitosus*) yields an abundant food to sheep on the Highland mountains in spring.—*Hooker.*

Medicinal Properties.—These are of little interest in this family. M. De Candolle mentions the roots of *Carex arenaria. C. disticha*, and *C. hirta* as being diaphoretic and demulcent; they are called "Salsepareille d'Allemagne," or German Sarsaparilla. The roots of *Cyperus longus* and *C. rotundus* are bitter and slightly astringent and aromatic, and may be used as tonics and stomachics.—*Richard.*

The Cyperaceæ and Gramineæ are made a separate division of monocotyledons by Mr Lindley, under the name *Glumaceæ*. All the others he includes in another division called *Petaloideæ*.

MONOPERIGYNEÆ.

Monocotyledonous plants, with perigynous stamens.

16. Palmæ.
17. Junceæ.
18. Alismaceæ.
19. Colchicaceæ.
20. Asparagineæ.
22. Liliaceæ.
23. Bromeliaceæ.

ORDER XVI.

PALMÆ.—PALMS.

Characters.—In general large trees, with a cylindrical unbranched stem, sometimes shrubby. Stem has circular scales, formed by the persistent bases of the leaves. Leaves in a cluster at the top of the stem or stipe, large, persistent at the base, and often pinnate; sheathing, and plaited in the bud. Inflorescence a terminal spadix, covered before expansion by a coriaceous or even woody spatha. Spadices sometimes in clusters. Flowers occasionally hermaphrodite, oftener diœcious or polygamous. Perianth of 6 divisions, 3 internal and 3 external, like calyx and corolla, persistent. Stamens 6, seldom 3; opposite to, and at the base of, the segments of the perianth. Ovary 1- or 3-celled, or 3-lobed, each cell 1-seeded, ovule erect. Pericarp a berry or fibrous drupe, containing a bony nut; albumen at first tender, afterwards horny; embryo small, cylindrical, and situated horizontally in a lateral depression of the albumen.

EXAMPLES.—This is a well-known family, of a most elegant and majestic appearance. The Date Palm (*Phœnix dactylifera*), and the Cocoa-nut tree (*Cocos nucifera*), are the best known examples. The latter is about 60 feet in height, and has at the top upwards of 50 leaves, from 8 to 12 feet long, and nuts as large as a man's head. The Palms are found almost solely within the tropics, and most frequently in South America, India, and Africa.

They are of the greatest importance to the natives in some tropical climes, furnishing them with food, drink, clothing, and materials for huts, for thatching cottages, for bows, cloth, mats, baskets, brooms, oars, ropes, &c. The woody midribs and tough fibres of the leaves are of great use. Wax is obtained from the stem of the Wax Palm (*Ceroxylon andicola*). The kernels of the *Cocos butyracea* and *Elais guineensis* furnish palm oil. The oil of the *Cocos nucifera* is used for lamps. A kind of dragon's-blood is obtained from the *Calamus draco*.

ECONOMICAL PROPERTIES.—The terminal bud or cabbage of many of the Palms, when young, serves as food in various parts of India and Africa: that of the Cocoa-nut tree is much esteemed. The fruit of the Cocoa and Date Palms is valued both in their native countries and in Europe. The milk of the Cocoa-nut (a mild and refreshing drink) is contained within the kernel while growing. The milk diminishes in quantity, and becomes sharp and aperient, as the kernel ripens. The kernel is a common ingredient in curries. The substance called *Sago*, a nutritious article like

starch, is obtained from the soft central part of the stems of many of this family, particularly *Sagus farinifera, Phœnix f., Corypha umbraculifera, Caryota urens,* and the *Borassus gomutus* of Mr Crawford (*gomuti*), the latter of which also furnishes Toddy, from which the Malays make sugar. The spatha of the Cocoa tree and several others, when wounded, furnish a pleasant drink called *Toddy*. A spiritous liquor, a kind of *arrack,* is obtained by fermentation and distillation from the juice of the flowers and stem of the Date and other Palms, which contain a large quantity of saccharine matter. This is an inferior kind of arrack. It is the best, however, of several which receive promiscuously the name of *pariah arrack,* and which are much inferior to that obtained from rice. Sugar is also obtained from the toddy of the Cocoa tree, of the *Caryota urens,* and of the Palmyra tree (*Borassus flagelliformis*). All these sugars are common in the bazaars of India: they are altogether unrefined, and known by the English under the general name of *Jaggeries.—Ainslie,* i. 409. These three palms furnish the best kind of toddy. Palm wine is the fermented juice of several Palms, not subjected to the process of distillation. The best kind is that obtained from the *Elais guineensis.* The wine is obtained by scooping a cavity in the top of the stem, after cutting off the crown of foliage. The juice flows into the cavity at the rate of one gallon daily for a fortnight, gradually diminishing after that time. It is very sweet at first, but soon ferments and turns vinous. The *Areca catechu* furnishes the Betel-nut; see p. 203.

Medicinal Properties.—The Palms are of little

interest in a medicinal point of view. Toddy is said to have a gently aperient effect. The Betel-nut, when young and tender, is occasionally made into decoction, and given in costiveness from dyspepsia. A soft, downy, light brown substance, found on the outside of the lower part of the branches of the Cocoa-nut tree, where they spring from the stem, called Cocoa-nut cotton, is used by the Indians for suppressing hæmorrhage in cases of wounds, leech-bites, &c.—*Ainslie*, ii. 419.

Officinal Plant.
Cocos butyracea.

ORDER XVII.

JUNCEÆ.

This family resembles the Gramineæ and Cyperaceæ. They have a perianth formed of 6 glumaceous pieces, more or less in two rows; 6 stamens at the base of the perianth, or 3 opposite to the outer segments; ovary 1-celled or 3-celled, and 1-, 3-, or many-seeded, with 1 style and 3 stigmas; pericarp a 1-celled capsule, or with 3 incomplete cells and 3 valves, each having the dissepiment in the middle of its inner surface.

Examples.—This family consists of the extensive genus *Juncus* (Rush), and one or two more. Common Rush (*Juncus conglomeratus*), and Soft Rush (*Juncus effusus*), are much used for mats, chair-bottoms, the wicks of candles, &c.

ORDER XVIII.

ALISMACEÆ.

Included in the *Junci*, Juss.—*Alismaceæ*, *Butomeæ*, and *Juncagineæ*, of Lindley.

The inflorescence is a spike, umbel, or raceme; and the perianth consists of six herbaceous segments, of which the three inner are sometimes coloured. Stamens generally six, and ovaries many.

Water Plantain (*Alisma*) and Arrow-head (*Sagittaria*) exemplify Alismaceæ; Flowering-rush (*Butomus*) is an example of the Butomeæ; and Arrow-grass (*Triglochin*) of the Juncagineæ.

ORDER XIX.

COLCHICACEÆ.

Included in the *Junci* of Jussieu; *Melanthaceæ* of Brown and Lindley.

Characters.—Herbaceous plants, with fibrous or bulbous roots, and alternate sheathing leaves. Flowers mostly hermaphrodite, occasionally unisexual, terminal, in panicles, or in racemes on a naked scape. Perianth coloured, in 6 deep divisions, often tubular at the base. Stamens 6, opposite to the divisions of the perianth. Ovary 3-celled, or 3 1-celled ovaries in each flower; ovules many, attached to the inner angle of each cell; style trifid, or one to each cell or ovary; stig-

mas undivided and glandular. Pericarp a capsule, dividing into three pieces, dehiscing internally at the suture; carpels sometimes separate when ripe. Seed with a membranous or reticulated testa, and a fleshy albumen.

EXAMPLES.—Meadow Saffron (*Colchicum*), Hellebore (*Veratrum*), Bog-Asphodel (*Narthecium*), Scottish Asphodel (*Tofieldia*), Melanthium, Bulbocodium.

This important family is distinguished from the Junceæ by having a coloured perianth, carpels distinct or separating when ripe, and anthers turned outwards. The latter characters, together with the three styles and membranous testa, separate this family from the Liliaceæ.

MEDICINAL PROPERTIES.—The alkaline principle called *Veratrin* is found in several of this family,—in the bulb of Meadow Saffron (*Colchicum autumnale*), the tuberous root of White Hellebore (*Veratrum album*), and the capsules of Sabadilla (*Veratrum sabadilla*). These are drastic purgatives, violent emetics, narcotics, and also produce a powerful diuretic effect. They are very active medicines, have an acrid taste, and in too large doses produce great irritation of the intestinal canal. The *Eau medicinale* (a favourite remedy in gout) is supposed to owe its virtues to the presence of veratrum or of colchicum; and preparations of the latter are now much used in gout and rheumatism, and in dropsies. It allays the pain, and seems to act as a sedative. The tincture of the seeds, M. Richard mentions, is more energetic than that of

the bulb. The fleshy tubers of the *Colchicum illyricum* are also purgative, and the *Gloriosa superba* (*Methonica superba*) is said to possess the properties of the order in a high degree. The powder of the *Veratrum album* has been used as an errhine. The flowers and leaves in this family possess more or less the same properties as the roots and seeds.

Officinal Plants.

Colchicum autumnale.
Veratrum album.
Veratrum Sabadilla.

Poisonous Properties.—The same principle which renders this family so useful in medicine, produces very dangerous effects on the animal economy, when taken in too large a dose. Veratrine, when injected into a vein, causes death by tetanus, without any other apparent irritation. Plants of this family may be ranked among the narcotico-acrid poisons.

ORDER XX.

ASPARAGINEÆ.

Included in the *Asparagi*, Juss.—*Smilaceæ* of Mr Brown and Mr Lindley.

Characters.—Herbs or under-shrubs, with alternate leaves, sometimes sheathing; flowers hermaphrodite, sometimes diœcious; perianth often coloured and petaloid, 6 (occasionally 8) parted, sometimes appear-

ing a regular calyx and corolla (Paris); stamens of the same number as, and inserted into the base of, the divisions of the perianth; the three opposite the sepals occasionally absent or of a different form; ovary 3-celled (Paris 4-celled), cells 1, 2, or many seeded; style simple, with a 3-lobed stigma, or 3-parted; pericarp a capsule or roundish berry, sometimes 1-celled and 1-seeded from abortion; seed with a membranous testa, and a fleshy or cartilaginous albumen.

EXAMPLES.—Lily of the Valley (*Convallaria majalis*), Herb Paris (*Paris quadrifolia*), Butcher's Broom (*Ruscus aculeatus*), *Smilax sarsaparilla*, *Asparagus officinalis*.

ECONOMICAL PROPERTIES.—The young shoots or buds of the *Asparagus officinalis* form the Asparagus of our tables. M. Decandolle mentions that the root of *Smilax China*, (*Too-fuh* of the Chinese, *Squine* of the French), which is very thick and fleshy, is used as food in America. This plant is also in some parts of China used instead of Rice. The roots of most of this family are of a mucilaginous nature, being composed principally of mucilage and starch, mixed, however, with a little bitter matter.

MEDICINAL PROPERTIES.—The leading character of this family, in a medicinal point of view, is the demulcent, diaphoretic, and diuretic properties of their roots. Various species of Smilax possess these properties, particularly the *Smilax sarsaparilla*, *S. aspera*, and *S. China*. These are much used after a course of mer-

cury. The roots of *Asparagus officinalis* and *Ruscus aculeatus* possess similar properties. M. Broussais has proposed Asparagus as a substitute for Digitalis or prussic acid, when it is wished to diminish the force of the circulation, and lessen the heart's action, as it does not injure the stomach. The roots of Trillium are emetic, and the berries are to be avoided. Gum-dragon, a styptic, now little used, is obtained from the *Dracæna draco;* it is the juice of the plant.

Officinal Plant.

Smilax sarsaparilla.

There are no poisonous plants in this family.

ORDER XXI.

LILIACEÆ.

Lilia and *Asphodeli,* Juss.—Includes the *Hæmerocallideæ* of Mr Brown.

Characters.—Herbaceous plants, with bulbous roots. Leaves frequently all radical, alternate, and often very thick and fleshy. Flowers often solitary and terminal, upon a scape; sometimes in spikes, racemes, or umbels; often in a spatha, enclosing them before they expand. Perianth coloured and petaloid; single, and in 6 pieces, or occasionally disposed in two rows, (three inner pieces and three outer); segments often united at the base, and somewhat tubular, often distinctly monosepalous. Stamens 6, inserted into

the segments of the perianth. Ovary free and superior; 3-celled, with a variable number of seeds in two rows at the ventral suture; style simple or absent; stigma 3-lobed. Pericarp a 3-celled capsule, with a loculicidal dehiscence, and separating into three valves. Seed sometimes with a black, brittle, and crustaceous testa, sometimes membranous, and winged. Albumen fleshy, with a cylindrical embryo.

Examples.—Hyacinth, Tulip, Harebell (*Scilla nutans*, or *Hyacinthus non-scriptus*), Alöe, Squill, Onion. This family may be distinguished from the Asparagineæ by the capsular pericarp and bulbous root. In the Asparagineæ the root is mostly a creeping stem-like body, and the pericarp a berry.

Economical Properties.—The properties of the Onion (*Allium cepa*), the Leek (*Allium porrum*), and Garlic (*Allium sativum*), are well known. The strong but agreeable flavour of these plants renders them useful as condiments. Their stimulating properties seem to be owing to an acrid volatile oil. Their acridity is much diminished by cultivation. M. Richard observes that all the bulbs in this family contain a mucilage much resembling gum arabic; this, he says, is very abundant in the *Scilla nutans*.

Medicinal Properties.—The bulbs in this family contain two different principles, a mucilaginous or starchy matter, and a bitter and highly stimulating juice. It is most probably an acrid volatile matter which confers on them their flavour. M. Vogel found

that Squill (*Scilla maritima*) contains two distinct active principles, one an acrid volatile matter, which is decomposed at the temperature of boiling water, the other a bitter principle, soluble in alcohol and in vinegar, which he has called *Scillitin*, and which appears to be the principal cause of the action of Squill on the animal economy. The *Scilla maritima* is in great reputation as a diuretic and expectorant; it is also, in larger doses, emetic and purgative. The bulbous root of the *Erythronium indicum* has got the name of Squill in India, from its resemblance to the root of the *Scilla maritima* in appearance and natural qualities. The Onion and Garlic are also diuretic, and generally stimulant: the properties of the latter are said to be owing to a volatile oil; Garlic has been recommended as anthelmintic. The Alöe is in this order: it is also a general stimulant, mostly used for its cathartic properties. The *Alöe hepatica* or *perfoliata* furnishes the Barbadoes or hepatic Alöes, also obtained from the East Indies and from Arabia: it is an extract from the whole plant. The best kind of Alöes is that obtained from the leaves of the *Alöe spicata*, or Socotrine Alöe. The *Alöe spicata* is found " also in many parts of the south of Africa, such as in the kingdom of *Melinda*, where the greater part of the extract is prepared that is now sold under the name of Socotrine Alöes."—*Ainslie*, vol. i. p. 9. The drug is obtained in the form of an inspissated juice from the leaves; but a viscid amber-coloured juice, having much resemblance to the extract, also exudes from the plant, when it is cut. According to M. De Candolle, the roots of the *Scilla*

lilio-hyacinthus are purgative, and also the *Anthericum bicolor*.

Officinal Plants.

Allium porrum.	Alöe spicata.
Allium sativum.	Alöe perfoliata *.
Allium cepa.	Scilla maritima.

ORDER XXII.

BROMELIACEÆ.

Characters.—Leaves radical, narrow, rigid, channelled, and with spinous margins; inflorescence a spike, raceme, or capitulum; calyx and corolla 3 parted each; stamens 6.

This family is chiefly remarkable for containing the Pine Apple (*Bromelia ananas*), so much valued for its fruit. A species of Wild Agave in Mexico contains a considerable quantity of saccharine juice, used for making, by fermentation, a kind of wine called *Pulque*. The leaves of the *Agave Americana* furnish an extract similar in properties to that of the Aloe. The plants in this family are mostly inhabitants of South America.

* Some refer the Barbadoes Aloes to the *Alöe vulgaris*.

MONOEPIGYNEÆ.

Monocotyledonous Plants with epigynous stamens.

23. Dioscoreæ.
24. Narcisseæ.
25. Irideæ.
26. Musaceæ.
27. Scitamineæ.
28. Marantaceæ.
29. Orchideæ.
30. Hydrocharideæ.

ORDER XXIII.

DIOSCOREÆ.

Characters.—Twining plants, with alternate leaves and small diœcious flowers generally on a spike, a perianth of 6 pieces or 6 lobed, 6 stamens, a 3-celled ovary, and a capsular pericarp, often 1-celled by abortion. The leaves are reticulated like those of dicotyledonous plants.

Examples.—Black Bryony (*Tamus communis*), the Yam (*Dioscorea*).

Economical Properties.—The roots of the Yams are fleshy and mucilaginous, and much used as food in tropical countries. They also contain a little saccharine matter. The White Dry Yam (*Dioscorea alata*) is by far the best, and is indigenous in the Indian islands; the Purple Yam (*D. purpurea*) is much esteemed; in taste the Yams much resemble potatoes.—*Ainslie*, vol. i. 329. *Tamus communis* contains a considerable quantity of fecula, which may be turned to

good account by washing and roasting the root, to remove the acrid matter which it contains.

ORDER XXIV.

NARCISSEÆ.

Part of the *Narcissi*, Juss.—*Amaryllideæ* of Mr Brown.

Characters.—Herbaceous plants with bulbous roots, radical leaves, sheathing and ensiform; flowers solitary or umbellate on a scape, and enclosed in a spatha; perianth 6-partite, the divisions overlapping; orifice of the perianth sometimes having a petaloid nectary of a cylindrical form; stamens 6; ovary 3-celled, many seeded; style simple; stigma 3-lobed; pericarp a 3-celled, 3-valved capsule, with a loculicidal dehiscence, sometimes a berry with few seeds.

Examples.—Daffodill (*Narcissus*), Amaryllis, Snowdrop (*Galanthus*), Snowflake (*Leucojum*), *Hæmanthus*.

This family may be distinguished from the Liliaceæ by the inferior ovary; and from the Irideæ by being hexandrous.

Medicinal Properties.—The bulbs of all the plants of this family contain a small quantity of fecula, and a considerable quantity of an acrid, stimulating, gum-resinous matter, which appears to be analogous to that in Squill. The bulb of the *Narcissus pöeticus* is emetic, and the *N. odorus* and flowers of *N. pseudo-narcissus*

extremity. Ovary 3-celled, many seeded. Pericarp sometimes a capsule, sometimes fleshy.

Examples.—Plantain (*Musa*), Urania, Heliconia.

Economical Properties.—The Plantain (*Musa paradisiaca*) and the Banana (*M. sapientum*) belong to this family. Their fruit is very agreeable, and is much used as an article of food in tropical countries. They produce a very great quantity of fruit, and are plants of the greatest importance to the natives all over the torrid zone. "The Plantain is certainly one of the most delicious of all the Indian fruits, and one of the safest for such as have delicate stomachs, being entirely free from acidity; it is, moreover, very nourishing, and is always prescribed as food, by the Hindoo practitioners, for such as suffer from bile and heat of habit."—"The Plantain and Banana are the principal fruits of the Eastern islands; unripe, they are sliced and made into curry, when they taste like potatoes."—*Ainslie*, i. 316–7. Humboldt calculates that the produce of the Banana is to that of Wheat, on the same extent of ground, as 133 to 1, and to that of Potatoes as 44 to 1. With respect to its nutritive power the Banana is inferior to Wheat, but when the immense quantity of produce is considered, its nutritious matter is to that of Wheat as 25 to 1.

ORDER XXVII.

SCITAMINEÆ.

Forming along with Marantaceæ the *Cannæ*, Juss.; *Amomeæ*, Rich.; or *Drymyrrhizæ*, Decand.

Characters.—Herbaceous plants with a creeping root; simple, sheathing, and alternate leaves. Inflorescence a dense panicle or spike, accompanied by large membranous spathas. Calyx tubular, unequally 3-lobed. Corolla tubular, irregular, with 6 segments in two rows, 3 outer segments nearly equal, and 3 inner, of which two are equal and occasionally abortive, and a third (*labellum*) is longer than the rest, and often lobed; stamen 1, inserted into the tube of the corolla opposite the labellum. Anther 2-celled, the lobes occasionally embracing the upper part of the style. Ovary 3-celled, each cell many seeded; stigma dilated, hollow; at the base of the filiform style are two scales, considered abortive stamens. Pericarp a 3-celled 3-valved capsule, occasionally a berry. Seeds with a farinaceous albumen, and radicle next the hilum.

Examples.—Amomum, Curcuma, Zingiber, Kæmpferia.

This has been considered an anomalous family among the Monocotyledons, which have generally 3 or 6 stamens, and only 1 or 2 whorls in the perianth. They are considered as having 6 stamens, however, of which some are modified. Of these stamens one is fertile,

also have this property. They are also deemed anti-spasmodic.

Poisonous Properties.—In the form of extract, the last mentioned plants, particularly the *Narcissus pseudo-narcissus,* are said to be poisonous in the dose of two or three drachms. The bulb of the *Amaryllis disticha,* and several other species, contain a peculiar matter, in which the Hottentots dip their arrows to render them poisonous.

ORDER XXV.

IRIDEÆ.

Characters.—Herbaceous plants, with fibrous, tuberous, or solid bulbous roots; alternate ensiform leaves; flowers enclosed in a membranous spatha. Perianth coloured, 6 partite, tubular at the base, divisions often entirely separate. Stamens three, sometimes monadelphous. Ovary 3-celled, style simple, stigmas three, petaloid. Pericarp a 3-celled capsule, 3-valved, and with a loculicidal dehiscence. Seeds with a fleshy or horny albumen, numerous, and disposed longitudinally in two rows.

Examples.—Iris, Crocus, Gladiolus. The *Crocus sativus* furnishes saffron (the dried stigmata of the plant), a material used in dyeing. The seeds of *Iris pseudacorus* roasted, are recommended as a substitute for coffee,—*Hooker.*

Medicinal Properties.—The roots of some species of Iris, as Orris Root (*Iris florentina*), and *I. germanica*, are slightly stimulant, and may be used for keeping open an issue, for exciting salivation or the secretion from the nose, or as purgatives. *Iris pseudacorus*, *I. germanica*, *I. tuberosa*, *I. versicolor* and *I. verna*, are cathartic, and the two first are also brisk emetics. The roots of the Iris appear to contain gum, an astringent extract abundant in the *I. pseudacorus*, some fecula, an acrid and bitter oil, and a volatile oil, which exists mostly in the roots of those which are odorous. The stigmata of the *Crocus sativus* were formerly used in hysteria: they are aromatic, pungent, stimulant, and exhilarating, and have been said to resemble spirituous liquors in their action. They are now used only as secondary in pills and tinctures.

Officinal Plants.

Crocus sativus.
Iris florentina.

ORDER XXVI.

MUSACEÆ.

Characters.—Herbaceous stemless plants. Leaves with long sheathing petioles, with a kind of swelling between the petiole and the leaf. Flowers on a common stalk in the centre of the leaves, and contained in spathas. Perianth irregular, in two rows, 6-parted, and petaloid. Stamens 6, filaments membranous at the

the anther 1-celled, and in being destitute of that pungent aroma which characterises the Scitamineæ.

Examples.—Indian arrow-root *Maranta arundinacea*), Indian cane (*Canna*).

The existence of only one stamen in this family is explained in the same way as in the Scitamineæ.

Economical Properties.—The roots of the Marantaceæ contain a considerable quantity of fecula, which forms an article of food in the East and West Indies. The fecula is not combined, as in Scitamineæ, with a hot aromatic principle, and is very nutritious. The *Maranta arundinacea* affords the greatest quantity: the well known powder called "Indian Arrow-Root," is obtained from this plant. It receives the name of Arrow Root from its supposed virtues in extracting the poison communicated by poisoned arrows. Other species furnish a nutritious matter abundantly, as *Maranta nobilis*, and *M. ramosissima*.

ORDER XXIX.

ORCHIDEÆ.

Characters.—Herbaceous plants with a fibrous root, or a tuberous root variously divided, destitute of stem, or having a short one formed of the persistent bases of the leaves; leaves simple, alternate, sheathing; inflorescence a terminal spike, panicle, or raceme; flowers rarely solitary; calyx in 3 segments, usually coloured; one of

the segments higher than the others, which may be called the lateral ones ; corolla in 3 segments, usually coloured : two of the segments are lateral, on each side of the higher segment of the calyx, and themselves higher than the other segment of the corolla, which is called the *lip* or *labellum ;* it projects between the lateral pieces of the calyx, is of a different figure from the others, frequently lobed, and often with a hollow prolongation or spur at the base ; stamen 1 (2 abortive), forming, along with the style to which it is united, a column (*gynosteme*), arising from the top of the ovary ; and having at " its anterior and upper surface a glandular depression, which is the stigma, and at its summit, an anther with 2 cells, opening either by a longitudinal suture, or by a lid which forms the whole of its upper part. The pollen contained in each cell of the anther is united into a mass, which has the same form as the cavity which contains it. At the top of the gynosteme, at each side of the anther, there are found two small tubercles, which are two abortive stamens, and which are called *staminodes.* These two stamens are, on the contrary, developed in the genus *Cypripedium*, while the middle one is abortive."—*Richard**. Thus the anthers and stigma are united at the top of the column, and are opposite to the labellum ; ovary inferior, 1-celled, and with three parietal placentæ, with many small seeds. Style incorporated with the filament ; stigma facing the labellum, viscid ; pericarp a capsule dehiscing by 3-valves ; seed with a reticulated testa.

* Nouveaux Elemens de Botanique, p. 440.

the other five abortive or barren. In place of two of the barren stamens we have the two scales or tubercles, at the base of the style, and the other three are metamorphosed into the three inner petaloid segments, so that in reality there are only two rows in the perianth. In this manner, as M. Lestiboudois has pointed out, we can explain these apparent anomalies.

Economical Properties.—The roots of the plants in this family contain an aromatic stimulating principle which renders them agreeable as condiments, seasonings, &c. Ginger (*Zingiber officinale* of Mr Roscoe, *Amomum Zingiber*, Linn.) is the most notable of these, but there are several others, which may be used in the same way. *Curcuma angustifolia* is said, by Dr Ainslie, to furnish an excellent kind of arrow-root, and is now much grown on the Malabar coast. They all contain a considerable quantity of fecula, but, in general, not in a state to be used as food, being mixed and impregnated with their hot aromatic principle. Turmeric (*Curcuma longa*) is a constant ingredient in curries. This plant also furnishes a yellow dye.

Medicinal Properties.—A pungent volatile oil is found in almost all parts of the plants in this family. The roots and seeds are valued in medicine as aromatics, stomachics, &c. Ginger, Galangale (*Alpinia racemosa*, *A. galanga*), Turmeric, Zedoary, and Cardamom, are chiefly used. Lesser Cardamom seeds, so much employed in extracts, confections, and tinctures, are the produce of the *Amomum cardamomum* (*A. repens*, *Matonia cardamomum*); by some, the Lesser Car-

damom seeds are referred to the *Elettaria cardamomum*, and the Greater Cardamom seeds to the *Amomum granum paradisi*. The latter are more pungent and less aromatic than the Lesser Cardamom seeds, which are most esteemed. Dr Ainslie mentions three kinds of Zedoary, 1. The *Kæmpferia rotunda* or *Zedoaria rotunda*; 2. The *Curcuma zerumbet*, or *Amomum zerumbet*, found in the East Indies, Cochin China, and Otaheite, and said to be that which yields the Zedoary of the London druggists; and, 3, the *Curcuma zedoaria*, or *Amomum zedoaria* (Tumeric coloured). Tumeric is used in chemistry as a test for alkalis, which change the yellow colour to a brown.

Officinal Plants.

Amomum Zingiber.
Amomum cardamomum.
Amomum repens.
Curcuma longa.

ORDER XXVIII.

MARANTACEÆ.

Cannæ of Mr Brown.—Included in the *Cannæ* of Jussieu, and *Drymyrrhizæ* of De Candolle.

Characters.—Nearly the same as in the Scitamineæ. They differ from the preceding family in having the two lateral segments of the inner whorl of the perianth different from each other, the stamen adjacent, and not opposite to the labellum, the filament petaloid,

Examples.—Orchis; Cypripedium (Lady's Slipper); Malaxis (Bog Orchis); Ophrys; Epidendrum. They are found in all parts of the world, and chiefly in moist situations, and are remarkable for the beauty and stately elegance of their flowers. They are frequently parasitic.

The peculiar union of the sexual organs into one column, is sufficiently characteristic of this very natural family. The union of the granules of pollen into a mass, is another striking peculiarity which they present. Like the Scitamineæ and Marantaceæ they are considered to possess several stamens, of which all are abortive but one. In the Orchideæ the number abortive is two, thus still preserving the ternary division found in the Monocotyledons; the three filaments being united in the column, and the anthers only being deficient. This family also resembles the two preceding, in having its corolla with a labellum, but has only two rows of perianth, while they have three.

Economical Properties.—The fleshy tuberous roots contain a sweetish mucilaginous fecula, which is extracted in considerable quantities from the *Orchis mascula* and other species of Orchis, and sold under the name of *Salop* or *Salep*. Salep, Dr Ainslie mentions, is used by the Arabians in consumption; and is said to have the power of correcting the saltness of sea-water. The fleshy fruit of the Epidendrum vanilla furnishes the aromatic substance called *vanilla*. It is considered stomachic in South America, and in this country is employed to give a pleasant flavour to chocolate.

ORDER XXX.

HYDROCHARIDEÆ.

This is a family of little interest. It contains Frogbit *(Hydrocharis)*, Water-soldier *(Stratiotes)*, and one or two others.

SECTION II.

DICOTYLEDONEÆ.

Exogenæ of De Candolle,— *Exorhizæ* and *Synorhizæ* of Richard.

Characters.—Embryo with two opposite cotyledons, or several in a whorl. Radicle not enclosed in a sheath. Generally with a distinct calyx and corolla, or double perianth; which, and also the sexual organs, very frequently consist of 5 parts, or some multiple of 5; or occasionally of 2, or some of its multiples. Leaves often opposite, jointed at their union with the stem, and having their veins or nerves much and irregularly ramified. (See Frontispiece, Fig. 4.) Stem consisting of vascular and cellular tissue disposed in concentric cylinders round a central column of pith, and composed of two parts, wood and bark, between which the newly formed matter is added. (See Frontispiece, Fig. 2.)

Examples.—Oak, Elm, Rose, Pea, Poppy.

The Dicotyledoneæ are called *Exogenæ* from their mode of growth (109); and *Exorhizæ* (415) from the radicle being free. The *Synorhizæ* (417) are also included in the Dicotyledons.

Dicotyledonous plants are arranged in three subsections: the Apetalous, the Monopetalous, and the Polypetalous.

I. APETALEÆ.

Dicotyledonous plants, with a single perianth, or none.

The following is a list of the orders in this subdivision:—

31. Aristolochiæ.
32. Santalaceæ.
33. Cupuliferæ.
34. Juglandeæ.
35. Coniferæ.
36. Cycadeæ.
37. Salicineæ.
38. Betulineæ.
39. Myriceæ.
40. Euphorbiaceæ.
41. Urticeæ.
42. Myristiceæ.
43. Laurineæ.
44. Chenopodeæ.
45. Polygoneæ.
46. Thymeleæ.
47. Amaranthaceæ.
48. Nyctagineæ.

ORDER XXXI.

ARISTOLOCHIÆ.

Characters. — Herbs or shrubs with alternate simple leaves, with petioles and sometimes stipules,

and hermaphrodite axillary flowers; calyx with a valvate æstivation, monosepalous, with 3 lobes; stamens epigynous, 6 to 12, distinct and free, or united to the style and stigma; ovary 3- or 6-celled, many seeded; style simple when free; stigma 3- or 6-lobed; pericarp a capsule, 3- or 6-celled and many-seeded; seeds attached to the internal angle of each cell.

EXAMPLES.—Snake-root or Birthwort *Aristolochia serpentaria*); Asarabacca (*Asarum Europæum*):

Cytinus and *Rafflesia* are made a separate order by some, *Cytineæ*.

MEDICINAL PROPERTIES.—The roots of most of this family are acrid, stimulating, bitter, and aromatic. Snake-root is a tonic and stimulating diaphoretic; other species of Aristolochia possess similar properties, as *A. rotunda*, *A. longa*, and *A. clematitis*. The leaves of Asarabacca are emetic and purgative. They are used chiefly as errhine in the form of powder. *Asarum canadense* has similar properties. The fruit of the Hypocyst (*Cytinus hypocistis*) is astringent, owing to the presence of gallic acid, and Rafflesia is used as an astringent in Java.

Officinal Plants.

Aristolochia serpentaria.
Asarum europæum.

There are no poisonous plants among the Aristolochiæ.

ORDER XXXII.

SANTALACEÆ.

CHARACTERS.—Flowers in spikes; calyx 4- or 5-cleft; stamens 4 or 5; ovary 1-celled, inferior, with 1 to 4 ovules; style 1; pericarp a drupe, 1-seeded.

EXAMPLES.—Sanderswood (*Santalum album*) Thesium, Osyris.

ORDER XXXIII.

CUPULIFERÆ.

Included in the *Amentaceæ*, Juss.

CHARACTERS.—Trees or shrubs, with simple alternate leaves, having two caducous stipules at the base; inflorescence an amentum; flowers unisexual (mostly monœcious); stamens 5 to 20, inserted at the base of a scale or calyx somewhat divided; female flowers sometimes in a kind of capitulum; ovary surmounted by an imperfect superior calyx, and placed within a scaly involucre or cupule, 2-, 3-, or many-celled, each cell containing 1 or 2 pendulous ovules; stigmas 2 or 3, almost sessile; pericarp 1-celled, 1- or 2-seeded by abortion, dry, indehiscent, more or less enveloped in the bony cupule or involucre, and called nut or gland.

Examples—Oak (*Quercus robur*), Hazel (*Corylus avellana*), Beech (*Fagus sylvatica*), Spanish Chestnut (*Castanea vulgaris*, or *Fagus castanea*), Hornbeam (*Carpinus betulus*. Cork is the bark of *Quercus suber*. Quercitron is furnished by the *Quercus tinctoria*.

This family is distinguished by the superior scaly calyx, the cupule, and the gland having only 1 or 2 seeds.

Economical Properties.—The nuts of *Castanea vulgaris* are used as an article of daily food in the south of Europe,—*Hooker*. The pericarp, deprived of its scaly cupule, contains starch, gluten, and some saccharine matter. The Hazel-nut is well known as an article of food; and Acorns, the nuts of the Oak, are given to swine.

Medicinal Properties.—The bark of *Quercus robur* is well known for its astringent properties, depending on the tannin and gallic acid which it contains. The Gall-nut (a peculiar morbid growth on the young shoots, caused by an insect) is the produce of the *Quercus infectoria*. It is very astringent.

Officinal Plants.

Quercus robur.
Quercus infectoria.

There are no poisonous species among the Cupuliferæ.

ORDER XXXIV.

JUGLANDEÆ.

Included in the *Terebinthaceæ*, Juss.

Characters.—Trees with pinnated, alternate leaves; monœcious flowers on an amentum; calyx in the female flowers superior, and of four divisions; ovary 1-celled, 1-seeded, surmounted by the limb of the calyx and two stigmas; ovule ascending; pericarp a drupe, almost dry, or nut.

Examples.—Walnut, (*Juglans regia*), *Carya*.

Economical Properties. — The Walnut is well known. The seed contains a considerable quantity of a thick oil; in some places used instead of olive oil. The outer parts of the fruit are said to contain tannin and gallic acid.

ORDER XXXV.

CONIFERÆ.

Characters. — Trees or shrubs with a resinous wood, narrow and linear leaves, sometimes solitary, sometimes fascicled, with a scarious sheath at the base; flowers monœcious or diœcious, on an amentum; stamens variable in number, sometimes one, occasionally at the base of a scale, at other times naked, sometimes united by the filaments, at other times with sessile an-

thers; female flowers solitary, or on an oval amentum or cone, with the ovaries in the axillæ of imbricated bracteæ; ovary thin, flat, and scaly, 1-celled, 1-seeded; pericarps acheniums, generally forming a strobilus or cone; the female flowers are occasionally united in a kind of involucre, which becomes fleshy, as in the Juniper berry, containing about three minute acheniums, which are the true fruit, and in the Yew (*Taxus*); embryo in an oleaginous fleshy albumen, and included in two or more cotyledons; radicle in union with the albumen.

Examples.—Scotch Fir (*Pinus sylvestris*), Larch (*P. larix*), Spruce Fir (*P. abies*), Juniper (*Juniperus communis*), Yew (*Taxus baccata*), Cedar of Lebanon (*Larix Cedrus*).

Medicinal Properties.—The Coniferæ are valuable in a medicinal point of view, chiefly as furnishing the various kinds of resin so much used for cerates and plasters, and turpentines, with their volatile oils, which are active cathartics, diuretics, and anthelmintics. The resinous juice which exudes from the trees is called Turpentine; by distillation a volatile oil is driven off (Oil of Turpentine), and a solid matter remains, which is resin. The Wild Pine or Scotch Fir (*Pinus sylvestris*) furnishes common turpentine (*Terebinthina vulgaris*), from which oil of turpentine and common or yellow resin (*Resina flava*), are obtained. Common tar is also obtained from this tree by burning. Black pitch is a preparation of tar. The Larch (*Pinus larix*) furnishes Venice Turpentine and a volatile oil. The

Balsam Spruce (*Pinus balsamea*) yields Canada Balsam (*Terebinthina canadensis*). The Spruce Fir (*Pinus abies*) furnishes Common Frankincense (*Thus*), and Burgundy Pitch (*Pix abietina*). Silver Fir (*Pinus picea* or *Abies pectinata*) affords Strasburg Turpentine. The bark of the Hemlock Spruce (*Abies canadensis* or *Pinus c.*) is said to contain much of the tanning principle, and is used in Canada for the manufacture of leather. Much information regarding the various kinds of Fir will be found in the second volume of the Transactions of the Literary and Historical Society of Quebec.

The leaves of *Juniperus Sabina*, or Savine, are diaphoretic and emmenagogue; and the berries of *Juniperus communis* are stimulant and stomachic, and also diuretic. Olibanum was formerly said to be the resin of *Juniperus lycia;* it is now referred to *Boswellia serrata*, but *Juniperus lycia* still retains its place in the pharmacopœias. Sandarach is obtained from *Thuja articulata;* some refer it to *Juniperus communis.*

Officinal Plants.

Pinus sylvestris.
Pinus larix.
Pinus balsamea.
Pinus abies.
Juniperus sabina.
Juniperus communis.
Juniperus lycia.

Poisonous Properties.—The berries, or juicy involucres of the Yew (*Taxus baccata*) are deemed poisonous; they are sometimes eaten, but the seeds which they contain must be rejected. M. Richard mentions, that he was affected with a slight pain in the head from

reposing under the Yew: the leaves are considered narcotic. The leaves of *Juniperus sabina* are dangerous, being narcotic and very acrid.

ORDER XXXVI.

CYCADEÆ.

CHARACTERS.—Trees with an unbranched stem and pinnated leaves with parallel veins, resembling Palms, increasing by a single terminal bud; diœcious; female flowers in cones, or consisting of naked ovules (destitute of ovary) on the margins of imperfect leaves.

EXAMPLES.—Cycas, Zamia. Sago Palm (*Cycas circinalis*) furnishes a kind of sago, obtained from the soft central part of the tree.

ORDER XXXVII.

SALICINEÆ.

Included in the *Amentaceæ*, Juss.

CHARACTERS.—Trees or shrubs, with simple alternate stipulate leaves, and diœcious flowers on an amentum; stamens 2 to 20, at the base of a scale; ovary, at the base of a scale, 1- or 2-celled, with many erect ovules, attached to two parietal placentæ about the base of the cell; style absent, or very short; stigmas 2; pericarp an elongated dehiscent capsule, 1- or 2-celled, and 2-valved, many-seeded; seeds comose (hairy).

Examples.—This family consists of Willow (*Salix*) and Poplar (*Populus*).

Medicinal Properties.—The bark in the Salicineæ is generally astringent and bitter. The bark of common White Willow (*Salix alba*) has been recommended as a substitute for Cinchona Bark. It contains a peculiar principle, *Salicine*, resembling Quina. Some species have barks with nearly as much tannin as the Oak.

Officinal Plants.

Salix alba.
Salix fragilis.
Salix caprea.

ORDER XXXVIII.

BETULINEÆ.

Included in the *Amentaceæ*, Juss.

Characters.—This family resembles the last, but has monœcious flowers, sometimes in the male flower a calyx of several divisions, a 2-celled ovary, with one pendulous ovule in each cell; and the pericarp a membranous indehiscent 1-celled, 1-seeded nut.

Examples.—Birch (*Betula*), Alder (*Alnus*).

The Betulineæ contain tannin in their barks, which are also somewhat tonic.

ORDER XXXIX.

MYRICEÆ.

Characters.—Trees or shrubs, with alternate simple leaves, often dotted; unisexual flowers, on an amentum; a 1-celled 1-seeded ovary, with an erect ovule, surrounded by several hypogynous scales, which in some become fleshy; in others, the pericarp is dry and dehiscent.

Examples,—Sweet Gale, or Dutch Myrtle (*Myrica gale*). The berries of *Myrica cerifera* furnish a kind of wax.

ORDER XL.

EUPHORBIACEÆ.

Characters.—Herbs, shrubs, or trees, with simple (generally stipulate) leaves, and a milky acrid juice in many, especially the herbaceous kind; flowers monœcious or diœcious, solitary, in clusters, or within a common involucre; calyx inferior, of several (often 5 or 10) divisions, of which the more interior are sometimes petaloid; stamens free or united; female flowers with a calyx resembling that of the male flowers; ovary superior, sessile, or with a stalk, generally 3-celled, and with 3 sides (rarely 2, or more than 3 cells), each cell with 1 or 2 suspended ovules; styles generally 3; pericarp sometimes fleshy exteriorly, 3-celled (2 or more than 3 cells occasionally), the cells dehiscent,

1- or 2-seeded, 2-valved, and separating from each other with elastic force; embryo in the interior of a fleshy albumen.

Examples.—Butcher's Broom (*Ruscus aculeatus*), Sun-spurge or Little-good (*Euphorbia helioscopa*), Castor-oil plant (*Ricinus communis*), Box-wood (*Buxus sempervirens*).

Economical Properties.—The *Iatropha manihot*, or Mandiocca, furnishes Cassava and Tapioca, two varieties of starch, well known for their nutritious properties. The root contains a very large quantity of starch, mixed, however, with an extremely acrid poisonous milky juice: the poisonous principle is very volatile and is removed by washing and by heat. The root is reduced to a pulp or paste, by being bruised or grated; the paste is pressed in bags, to squeeze out the juice which contains the poisonous principle, and repeatedly washed with water, when *cassava* remains. The water with which the cassava has been washed, according to Richard, deposits a white farinaceous powder, which is *tapioca*. Dr A. T. Thomson applies the term Tapioca to the matter which is here called Cassava.

Medicinal Properties.—The Euphorbiaceæ are important in a medicinal point of view. They are, in general, very acrid and irritating; these properties reside in the milky juice in which they abound. The acrid principle, however, is very volatile, and easily expelled by heat. Gum euphorbium is the produce of *Euphorbia officinarum*, and also of *E. antiquorum* and

E. canariensis; it is an active, indeed violent emetic, cathartic, hydragogue, and errhine. The thick oil in the seeds of Caper Spurge (*Euphorbia lathyris*), and in those of *E. cyparissias*, has similar properties. The roots of *Euphorbia ipecacuanha*, *E. sylvatica*, *E. gerardiana*, *E. cyparissias*, and *E. pithyusa*, are said to be excellent substitutes for Ipecacuanha. The bark of *Croton cascarilla* is tonic and stimulant, and an agreeable carminative: some refer the bark commonly called cascarilla to *Croton eleutheria*. *Mercurialis annua* is emollient and laxative. The expressed oil of the seeds of *Croton tiglium* (Croton oil) is a drastic purgative; the seeds were formerly called "grana molucca." *Croton tinctorium* furnishes a kind of turnsol. Lac is the produce of *Croton lacciferum*. The leaves of Box (*Buxus sempervivens*) are sudorific and laxative. The expressed oil (which may be obtained also by decoction) of the seeds of the *Ricinus communis* or *Palma Christi* is a mild purgative, well known by the name of castor oil. The acrid principle which this oil contains is expelled by being subjected to a moderate heat. The seeds of the *Anda Gomesii* are also purgative; those of the *Iatropha curcas* are violently cathartic. Caoutchouc is furnished by the *Hevea guyannensis*, and several other plants in this family.

Officinal Plants.

Euphorbia officinarum.	Croton tiglium.
Croton cascarilla.	Ricinus communis.

Poisonous Properties.—Many plants in this family are very active poisons: the milky juice in which they

abound is very deleterious, and almost all are more or less dangerous; many of the valuable medicines which we find in this family would be poisonous in large doses. The Manchin Eel tree (*Hippomane manchinella*), which is said to be capable of poisoning persons who may happen to sleep beneath it, is in this family. Dr Hooker mentions that Irish Spurge (*Euphorbia hiberna*) "is extensively used by the peasantry of Kerry for poisoning or rather stupifying fish, in the same manner as the exotic *E. piscatoria.* So powerful are its qualities, that a small creel or basket filled with the bruised plant, suffices to poison the fish for several miles down a river." The juice of *Excœcaria Agallocha*, and of *Hura crepitans*, is very deleterious. The fruit of *Hyœnanche globosa*, according to Dr Ainslie, is used at the Cape of Good Hope to poison hyenas. The various species of Iatropha, and indeed most of the plants in this family, are highly poisonous.

ORDER XLI.

URTICEÆ.

CHARACTERS.—Trees or herbs with alternate stipulate leaves; flowers monœcious or diœcious, in clusters or in heads; calyx sometimes monosepalous, deeply divided, sometimes polysepalous, generally persistent, accompanying the fruit; stamens about 4 or 5 at the base of the calyx; ovary superior, 1- or 2-celled, each cell 1-seeded, 1 or 2 stigmas; pericarp an indehiscent drupe or achenium, often with the calyx surrounding

it; female flowers often in the internal part of a hollow receptacle or involucre, which becomes fleshy, or placed upon this receptacle forming a fleshy head; seed destitute of albumen.

EXAMPLES.—Hop (*Humulus lupulus*); the Banyan tree (*Ficus religiosa*); Fig (*Ficus carica*); Nettle (*Urtica dioica*); the well known plant which furnishes Hemp (*Cannabis sativa*); Mulberry (*Morus nigra*). The bark of *Morus papyrifera* (*Broussonetia p.*) furnishes the paper of the Chinese.

There are three divisions in this family; 1. the true Urticeæ, with 1-celled ovaries, erect ovules, fruit dry, and flowers in a raceme or panicle, exemplified in Urtica and Humulus; 2. the Ulmaceæ (*Ulmus*), with 2-celled ovaries and pendulous seeds; and, 3. the Artocarpeæ (*Artocarpus*), with the flowers in fleshy heads, ovules suspended, and fruit a fleshy receptacle with nuts in fleshy calyces, or a fleshy receptacle or involucre enclosing the pericarps or acheniums (*Ficus*).

ECONOMICAL PROPERTIES.—The true URTICEÆ contain no plants useful in domestic economy except the Hop (*Humulus lupulus*), which is valued in brewing for the bitter quality of its strobili or cones. The ARTOCARPEÆ contain the Bread-fruit tree (*Artocarpus incisa*), the fruit of which is a valuable article of food in some tropical countries; the Fig-tree (*Ficus carica*); the Mulberry-tree (*Morus nigra*), *Morus tinctoria*, the wood of which yields fustic, a yellow die; the Cow-tree (*Palo de Vacca* or *Galoctodendron utile*), which furnishes abundantly a nutritious juice resembling milk.

ORDER XLIII.

LAURINEÆ.

CHARACTERS.—Trees or shrubs, with firm, coriaceous, and persistent, alternate leaves, seldom lobed, and generally smooth and shining; inflorescence an umbel or panicle; calyx monosepalous, with 6 (rarely 4) divisions; stamens perigynous, with glands at the base, from 6 to 9, of which the 3 inner are abortive; anthers 2 or 4-celled, dehiscing by a longitudinal lid or valve which opens from the base to the apex; ovary superior, 1-celled, 1-seeded; ovule pendulous; style and stigma simple; pericarp a drupe, of which the base is enveloped by the persistent calyx; seed without albumen; cotyledons thick; embryo inverted.

EXAMPLES.—Common Sweet Bay (*Laurus nobilis*), Cinnamon-tree (*L. cinnamomum*). Found chiefly within the tropics.

ECONOMICAL PROPERTIES.—The use of the bark of *Laurus cinnamomum* as a spice is well known.

MEDICINAL PROPERTIES.—All the parts of these plants contain an aromatic volatile oil, which renders them warm and carminative. The *Laurus cinnamomum* is astringent, tonic, and cordial; its volatile oil is powerfully stimulant. *Laurus malabrathum, L. cupularis,* and several other species, furnish a kind of cinnamon. The bark and flower buds of *Laurus cassia*

have similar properties. Camphor is obtained from the wood of *Laurus camphora* *; it is narcotic and diuretic. Laurel leaves, from the *Laurus nobilis*, are narcotic and carminative; they contain hydrocyanic acid. The berries with their fixed oil are of a similar character. The wood and bark of Sassafras (*Laurus Sassafras*) are diaphoretic and diuretic.

Officinal Plants.

Laurus cinnamomum.
Laurus cassia.
Laurus camphora.
Laurus nobilis.
Laurus sassafras.

ORDER XLIV.

CHENOPODEÆ.

Atriplices, Juss.

Characters. — Shrubs or herbs, with alternate leaves (rarely opposite), without stipules; flowers small, occasionally unisexual; calyx monosepalous, persistent, with 2, 4, or 5 deep divisions; stamens perigynous, of the same number as, or fewer than, the segments of the calyx, to which they are opposite; ovary superior, 1-celled, 1-seeded; ovule erect; style of 2 or 4 divisions; pericarp thin and membranous, rarely fleshy; embryo curved round mealy albumen.

Examples.—Spinach (*Spinacia oleracea*), Beet (*Be-*

* It is mostly obtained from the *Dryobalanops camphora*. See Guttiferæ.

Cecropia peltata, it is said, is one of the plants which afford caoutchouc; this is also obtained from *Ficus elastica* in this order, and from some Apocyneæ and Euphorbiaceæ.

Medicinal Properties.—The Mulberry is cooling and laxative, and contains a considerable quantity of mucilage. The Hop is narcotic, sedative, and diuretic. The virtues depend on a peculiar principle called *lupulin*. The bark of the Elm (*Ulmus campestris*) is deemed diuretic. The Fig is a demulcent and gentle laxative. Contrajerva root is obtained from *Dorstenia contrajerva:* it is sudorific and tonic.

Officinal Plants.

Humulus lupulus.	Ficus carica.
Ulmus campestris.	Dorstenia contrajerva.
Morus nigra.	

Poisonous Properties.—The leaves of Nettles (*Urtica urens*, *U. dioica*, and *U. pilulifera*) are covered with hairs, which are the excretory ducts of glands situated at the bases of the hairs; the pain and irritation caused by their sting arise from the fluid of the gland being poured into the skin. *Urtica stimulans* and *U. crenulata* produce similar effects, but are much more violent. The Upas of Java (*Antiarris toxicaria*) is one of the most deadly poisons known. It is said that a single seed introduced into the cellular tissue of a dog is sufficient to kill the animal. Its poisonous properties seem to depend on *Strychnine*, the same alkaline principle which characterizes *Nux vomica*. The

Upas belongs to the Artocarpeæ, many of which contain an acrid milky juice. The juice of *Ficus toxicaria* is very poisonous. The emanation from a Hemp or a Hop plantation is said to be injurious: the leaves of the former are narcotic in a high degree.

ORDER XLII.

MYRISTICEÆ.

Characters.—Trees with entire alternate leaves, diœcious, with a 3-lobed calyx; stamens monadelphous; anthers 4 to 12, sometimes united; ovary superior, 1-celled, 1-seeded; ovule erect; style short, with 2 stigmas, or 1 lobed stigma; pericarp a kind of drupe or berry, 2-valved, with a seed enclosed in an arillus in many narrow slips, and having an oily or fleshy albumen.

Examples.—Nutmeg-tree (*Myristica moschata*), a native of the Molucca Islands, and now cultivated in Sumatra.

Medicinal Properties.—Nutmeg and Mace are the produce of the *Myristica moschata.* Nutmeg is the kernel or seed with the albumen, and Mace is the fleshy arillus which envelopes the seed. They are aromatic (forming an agreeable spice), stimulant, carminative, and narcotic in large doses; and furnish an expressed and a volatile oil.

Officinal Plant.

Myristica moschata.

this family are purgative, emetic, and astringent. This latter property also resides in the young leaves; these have a sharp acidulous taste. *Polygonum bistorta* has a place in the pharmacopœias as astringent and tonic; the root contains tannin, gallic acid, and oxalic acid. The root of Water Dock (*Rumex aquaticus*) is powerfully astringent, and was formerly used in cases of scurvy, under the name of *Herba britannica*. The leaves of Common Sorrel (*R. acetosa*) are refrigerant and diuretic; they have an acid taste, and contain binoxalate of potassa and tartaric acid. M. Richard states, that they are an antidote to acrid substances, as a *ranunculus*, the effects of which they almost instantly neutralize. *R. acutus*, *R. scutatus*, *R. acetosella*, and several others, are used in the same way as Sorrel in different countries. Common Dock (*R. patientia*) is astringent, stomachic, and purgative, and is recommended by Dr A. T. Thomson in ichthyosis. *R. crispus* and *R. obtusifolius* have similar properties. The most useful plant in the Polygoneæ is *Rheum palmatum*, the root of which furnishes rhubarb, a favourite and useful stomachic and purgative, and also astringent. Wave-leaved Rhubarb (*Rheum undulatum*) is also believed to furnish some of the rhubarb of commerce. There are three kinds of rhubarb, Russian, Turkey, and Chinese rhubarb. Its virtues are said to be dependent on a peculiar principle called *rheumine;* it also contains a yellow colouring matter called *rhabarbarine*, oxalate of lime, and gallic acid. Other species possess similar properties, as *R. compactum*, *R. rhaponticum*. *Coccoloba uvifera* is powerfully astringent.

Polygonum hydropiper has an acrid and caustic juice, and is also a rubefacient.

Officinal Plants.

Rheum palmatum.	Rumex acetosa.
Rheum undulatum.	Rumex aquatica.
Polygonum bistorta.	

ORDER XLVI.

THYMELEÆ.

Characters.—Shrubs with alternate leaves, a monosepalous, tubular, petaloid, superior, 4- or 5-cleft calyx, sometimes persistent; stamens inserted in the tube, generally 8 or 4; ovary superior, 1-celled, 1-seeded; ovule pendulous; style and stigma simple; pericarp a drupe or achenium.

Examples.— Spurge Laurel (*Daphne mezereum*), Passerina. *D. gnidium* and *P. tinctoria* furnish a yellow dye. The Lace-bark tree is a species of Daphne, *D. lagetto.*

Medicinal Properties.—The inner bark of several species of Daphne, especially *D. mezereum*, and also the leaves and fruit, are extremely acrid and caustic, producing great heat in the mouth when chewed, and being even capable of exciting vesication when applied to the skin. *D. mezereum* is a stimulating diaphoretic,

ta vulgaris), Glasswort (*Salicornia*), Strawberry Spinach (*Blitum*).

Economical Properties.—Many of this family are favourite pot-herbs, as Garden Orach, (*Atriplex hortensis*), Spinach (*Spinacia oleracea*). The roots of the Beet and Mangel Wurzel are much esteemed : the former was at one time used in France for the preparation of sugar. The Salsolas (Saltworts) and Salicornias (Glassworts) abound in soda, so much used for making glass and soap, and for medicinal preparations. The soda of commerce is obtained principally from *Salsola kali*, *S. soda*, *S. tragus*, *Salicornia herbacea*, *S. arabica*, *Chenopodium setigerum*, *C. fruticosum*, belonging to this family; *Mesembryanthemum nudiflorum*, *Fucus vesiculosus*, and one or two others. M. Richard mentions that the best soda is obtained from *Chenopodium setigerum*, and some species of Salsola. It is from these that *Barilla*, which contains a purer soda than Kelp, is obtained.

Medicinal Properties.—*Chenopodium ambrosiodes* and *C. botrys* are mentioned by Richard as stimulating and aromatic, and are said to be antispasmodic. *C. anthelminticum* furnishes worm-seed oil, considered a good anthelmintic in North America. *Petiveria alliacea* is considered in Brazil a powerful sudorific.

There are no poisonous plants in this family.

ORDER XLV.

POLYGONEÆ.

Characters.—Herbaceous (seldom woody) plants, with alternate leaves, having stipules which form a thin membranous sheath (*ochrea*) round the stem; flowers small, greenish (sometimes coloured), often in clusters; calyx inferior, monosepalous, in 3, 5, or 6 divisions, persistent; stamens in the bottom of the calyx, which is there lined with a perigynous disk; ovary superior, 1-celled, 1-seeded; ovule erect; stigmas 2 or 3, occasionally sessile, sometimes with styles; pericarp small, a triangular achenium, enveloped by the calyx which is sometimes fleshy; albumen farinaceous.

Examples.—Bistort or Snakeweed (*Polygonum bistorta*), Rhubarb (*Rheum palmatum*), Sorrel (*Rumex acetosa*).

Economical Properties.—The seeds of Buckwheat (*Polygonum fagopyrum*) contain a considerable quantity of starch and gluten, and are used for being made into bread in Britanny and Normandy. In Iceland, the recent root of Bistort (*Polygonum bistorta*) is eaten raw, or made into bread. In France the leaves of Sorrel are used for the table. The leaf-stalks of Rhubarb have a pleasant acid taste, and are much used for tarts.

Medicinal Properties.—The roots of many of

but apt to excite vomiting and purging. *Daphne laureola* and *D. gnidium* are of a similar character.

Officinal Plant.

Daphne mezereum.

Poisonous Properties.—M. Richard states that, taken internally, the bark of *Daphne gnidium* produces effects similar to those of the acrid and corrosive poisons: he considers it a very energetic poison. The berries of *D. laureola* and of *D. mezereum* are deemed poisonous.

ORDER XLVII.

AMARANTHACEÆ.

This order contains the Amaranth, Gomphrena, &c. It is one of little interest. The leaves of some are mucilaginous.

ORDER XLVIII.

NYCTAGINEÆ.

This order contains the Marvel of Peru (*Mirabilis Jalapa*, or *Nyctago hortensis*), which was formerly supposed to be the Jalap plant. The roots of many are purgative.

II. MONOPETALEÆ.

Dicotyledonous plants with a monopetalous corolla.

I. HYPOCOROLLEÆ.

Monopetalous dicotyledonous plants with hypogynous stamens, mostly inserted in the corolla, and inferior ovaries.

49. Plantagineæ.
50. Plumbagineæ.
51. Primulaceæ.
52. Globularineæ.
53. Orobancheæ.
54. Scrophularineæ.
55. Solaneæ.
56. Acanthaceæ.
57. Jasmineæ.
58. Verbenaceæ.
59. Labiatæ.
60. Boragineæ.
61. Convolvulaceæ.
62. Bignoniaceæ.
63. Gentianeæ.
64. Apocyneæ.

ORDER XLIX.

PLANTAGINEÆ.

Characters.—Herbs with ribbed leaves, mostly radical, and flowers in spikes on a scape, hermaphrodite (rarely unisexual); calyx persistent, of 4 divisions; corolla tubular, 4-lobed; stamens 4, inserted into the corolla, and alternate with its segments; ovary 2 (seldom 4) celled, with a filiform style; pericarp a 2-celled 2-valved capsule, with a transverse dehiscence.

Examples.— Greater Plantain (*Plantago major*), Plantain Shore-weed (*Littorella lacustris*). The latter

of these genera is monœcious, and its flowers are solitary.

Medicinal Properties.—The leaves and root of *Plantago major* are slightly astringent. The seeds of *P. arenaria* and *P. psyllium* are emollient, and contain a large quantity of mucilage; they were at one time used for collyria. They are also used to prepare and stiffen muslins.

There are no poisonous plants among the Plantagineæ.

ORDER L.

PLUMBAGINEÆ.

Characters.—Herbs or shrubs, with alternate or radical leaves sheathing at the base; inflorescence a spike, capitulum, or sort of panicle; calyx tubular and persistent, plaited; corolla of 5 divisions, (sometimes very deep, almost polypetalous); stamens 5; ovary 1-celled, 1-seeded; ovule pendulous, attached to the apex of a filiform podosperm, which rises from the bottom to the top of the cell; styles about 5, with the same number of stigmas; pericarp a capsule, covered by the calyx, sometimes indehiscent, or dehiscing by 5 valves.

Examples.—Thrift or Sea Gillyflower (*Statice armeria*), Leadwort (*Plumbago europæa*), Taxanthema.

Medicinal Properties.—Many of the plants in this family are acrid and astringent; *Statice caroliniana* is

said to possess the latter property in a high degree. The fresh leaves and root of *Plumbago europæa* are extremely acrid and caustic; the leaves are employed in some cutaneous diseases. *P. scandens* is also very acrid, and is called *Herbe du Diable* in St Domingo.—*Lindley*.

ORDER LI.

PRIMULACEÆ.

Characters.—Pentandrous plants with a 1-celled ovary, with numerous ovules on a free central placenta, 1 style, and a dehiscent capsule.

Examples.—Primrose (*Primula vulgaris*), Water Violet (*Hottonia palustris*), Sow-bread (*Cyclamen europæum*), which is eaten in Sicily by the wild boars: this plant is generally deemed an acrid poison. This family is interesting chiefly for the beauty of its flowers, which has rendered the Cowslip (*Primula veris*) and Primrose such universal favourites.

ORDER LII.

GLOBULARINEÆ.

Characters.—Tetrandrous plants, with a bilabiate corolla, a 1-celled, 1-seeded ovary, and an indehiscent pericarp; inflorescence a capitulum.

Example.—Blue Daisy (*Globularia*). The leaves

of *Globularia alypum* are bitter and acrid, and deemed purgative.

ORDER LIII.

OROBANCHEÆ.

CHARACTERS.—Leafless, parasitic herbs, with brownish scales on the stem; a persistent corolla; 4 didynamous stamens; a 1-celled ovary, with 2 or 4 many-seeded parietal placentæ; and 1 style, with a 2-lobed stigma.

EXAMPLES. — Toothwort (*Lathræa squamaria*), Broom-rape (*Orobanche major*), which is parasitic on the roots of Broom and Furze.

ORDER LIV.

SCROPHULARINEÆ.

Personatæ, Linn.—*Pediculares* and *Scrophulariæ*, Juss.—*Antirrhinæ* and *Rhinanthaceæ*, De Cand.

CHARACTERS.—Herbs (rarely shrubs), with leaves mostly opposite, and flowers sometimes in spikes, but variously arranged; calyx monosepalous, persistent, generally 4 or 5 cleft; corolla deciduous, more or less irregular, imbricated in æstivation; stamens 2, or 4 didynamous, attached to the corolla; ovary 2-celled, many-seeded; style 1; stigma 2-lobed; pericarp a 2-celled capsule, dehiscing by 2 valves, each sometimes bearing on the middle of its internal surface one part of

the dissepiment, which is formed of the incurved margins of the valves, by 4 valves, or by pores at the upper part of each cell (*Antirrhinum*); seeds many, fixed to a central placenta, and having a fleshy albumen.

Examples. — Speedwell (*Veronica*), Snap-dragon (*Antirrhinum*), Foxglove (*Digitalis*), Yellow Rattle (*Rhinanthus*), Cow-wheat (*Melampyrum*).

This family bears a considerable resemblance to the Solaneæ. The latter have alternate leaves, a regular corolla, and stamens equal in number to the lobes of the corolla. The Scrophularineæ have opposite leaves, an irregular corolla, and 2, or 4 didynamous stamens.

Medicinal Properties.—These are various, but most of the plants in this family are somewhat acrid. The leaves of Brooklime (*Veronica beccabunga*) are bitter, acrid, and somewhat stimulant and diuretic; they are also deemed antiscorbutic. The leaves of *Veronica officinalis* are bitter and aromatic. *V. chamædrys*, *V. teucrium*, and *V. spicata*, have similar properties. The herbaceous part of Hedge Hyssop (*Gratiola officinalis*) is an active emetic, diuretic, and cathartic, " producing, in very large doses, all the effects of an irritative poison."—*Dr A. T. Thomson.* Its properties reside in a bitter matter of a resinous character. Knotty-rooted Figwort (*Scrophularia nódosa*) has a place in the Pharmacopœias as diuretic and sedative, and *S. aquatica* is purgative : they are seldom if ever used. The most notable plant in this family is Purple Foxglove (*Digitalis purpurea*); the leaves and seeds of this plant are powerfully sedative and diuretic, and the various pre-

parations are deemed of great value when it is wished to diminish the force of the circulation, and lessen the heart's action. Its properties are said to depend on an alkaline principle, which has received the name of Digitaline. Eye-bright (*Euphrasia officinalis*) is bitter and slightly aromatic, and was formerly used in diseases of the eye.

Officinal Plants.

Veronica beccabunga.	Scrophularia nodosa.
Gratiola officinalis.	Digitalis purpurea.

Poisonous Properties.—*Gratiola officinalis* is characterized by M. Richard as a dangerous plant, and *Digitalis* is poisonous; it may be considered an acro-narcotic or sedative poison.

ORDER LV.

SOLANEÆ.

Characters.—Herbs or shrubs, with alternate leaves, and flowers variously arranged; calyx monosepalous, in 5 (rarely 4) divisions, more or less deep, persistent; corolla with a plaited æstivation, rotate, funnel-shaped, or campanulate, with the limb 5-cleft, (rarely 4), regular (except in Verbascum); stamens 5, (occasionally 1 somewhat abortive), inserted in the corolla, and alternate with its segments; ovary 2-celled, with 2 many-seeded placentæ; style and stigma simple; pericarp a 2-celled 2-valved capsule (Datura is 4-celled

and 4-valved), or a berry 2-celled, or with many cells from enlargements of the placenta; embryo curved, in the interior of a fleshy albumen.

Examples.—Henbane (*Hyoscyamus niger*), Deadly Nightshade or Dwale (*Atropa belladonna*), Potato (*Solanum tuberosum*), Tobacco (*Nicotiana tabacum*). *Nolana* has a 5-lobed ovary, each lobe having 1 or 2 1-seeded cells. *Nicotiana multivalvis* has several cells external to the 2 central ones of the ovary.

Economical Properties.—The Potato is the fleshy tuber which grows on the roots or subterraneous branches of *Solanum tuberosum*, It consists almost entirely of a nutritious fecula, but is said to contain an acrid or narcotic principle; this, however, is in a very small proportion, and is dissipated by heat, as in boiling or roasting. The tubercles of *S. montanum* and *S. Venezuelæ* are of a similar nature.—*Richard.* The same author informs us, that in some countries the leaves of *S. nigrum* are boiled and eaten in the same manner as Spinach, and that the fruit is also much used in some places. The fruit of the Egg-plant (*Solanum melongena* or *S. esculentum*) is much used as an article of food in the West Indies, and in some provinces in France. The fruit of *S. lycopersicum* (Tomato or Love-apple) is frequently used for sauces; and the fruits of other species of Solanum, belonging to the Tomato section, are eatable. All these, however, are exposed to heat before being eaten. "It is stated that the poisonous species derive their properties from the presence of a pulpy matter which

surrounds the seeds; and that the wholesome kinds are destitute of this pulp, their fruit consisting only of what botanists call the Sarcocarp; that is to say, the centre of the rind in a more or less succulent state.'—*Lindley*. The dried berries and seeds of *Capsicum annuum* are known by the name of Cayenne Pepper; they are hot, pungent, and aromatic, and are used as a condiment. *C. frutescens* and *C. baccatum* have similar properties. The fruit of the Winter Cherry (*Physalis alkekengi*) is also used as a condiment.

Medicinal Properties.—The general character of this family, in a medicinal point of view, is narcotic. The root and leaves of *Atropa belladonna* are powerfully narcotic. Mr Brandes discovered in this plant an alkali (*Atropia*), on which its narcotic properties depend, so extremely powerful, that the utmost caution is required in experimenting with it. The chief use of Belladonna is to dilate the pupil before the operation for cataract: abroad, it is used in hooping-cough. The herb and seeds of Henbane (*Hyoscyamus niger*) are also narcotic, and used in the same way as opium, where the use of the latter is inadmissible; the plant contains a peculiar alkali (*Hyoscyama*). *H. albus* and *H. aureus* have similar properties. The extreme twigs of Woody Nightshade or Bitter-Sweet (*Solanum dulcamara*) are narcotic, diaphoretic, and diuretic, but little used: an excellent bitter and tonic, said to be nearly equal to that of Cinchona, is obtained from the *Solanum pseudo-quina*. Solanum also contains a vegetable alkali (*Solanine*). The herb and seeds of Thorn Apple (*Datura stramonium*) are of a somewhat similar na-

ture; smoking the plant has been recommended during the paroxysm of asthma. Mr Brandes has found in this plant a vegetable alkali (*Daturine*), on which its properties seem to depend. The leaves of the Tobacco plant (*Nicotiana tabacum*) are narcotic, cathartic, emetic, diuretic, or errhine, according to the mode in which they are employed. Their use in the form of snuff or for smoking, is well known. The fruit of *Capsicum annuum* is an active stimulant and carminative, and is said to be destitute of any narcotic property. The leaves of the Mullein (*Verbascum thapsus*) are gently anodyne and emollient. The fruit of the Winter Cherry (*Physalis alkekengi*) is diuretic.

Officinal Plants.

Atropa belladonna.
Solanum dulcamara.
Hyoscyamus niger.
Datura stramonium.
Nicotiana tabacum.
Verbascum thapsus.
Capsicum annuum.

Poisonous Properties.—All the plants of the above list, except the two last and perhaps *Solanum dulcamara*, are violent narcotic poisons. The Mandragore, a powerful poison, is a species of Atropa (*A. mandragora*): the root is the most dangerous part of the plant, but the fruit is also poisonous. The berries of *A. belladonna* have sometimes proved fatal to children. The volatile oil obtained from the leaves of Tobacco is a most virulent poison, and used by the Hottentots to poison snakes: its effects, when applied to the tongue, are almost instantaneous.

ORDER LVI.

ACANTHACEÆ.

Characters.—This family resembles the Scrophularineæ. They are distinguished by having bracteæ (3) to each flower, a bilabiate corolla, a capsule dehiscing with elasticity into 2 valves, and an embryo with large cotyledons, and no albumen. The cells of the ovary are 2- or many-seeded; ovary in a circular disk; stamens 2, or 4 didynamous.

Acanthus mollis is considered emollient; and several species of *Justicia* are reckoned stomachic and antispasmodic.

ORDER LVII.

JASMINEÆ.

Jasmineæ and *Oleaceæ*, Lindley.—*Oleineæ*.

Characters.—Trees or shrubs, with opposite leaves, simple or pinnate, and having their inferior surfaces often dotted; inflorescence a raceme, panicle, or corymb; flowers occasionally diœcious; calyx monosepalous, of 4 or 5 teeth or divisions, persistent; corolla regular, with a limb of about 4 or 5 divisions; stamens 2, inserted in the corolla; ovary 2-celled, each cell 2-seeded; style 1; stigma 2-lobed or bifid; pericarp a capsule of 2 cells, each containing 1 or 2 seeds, or a berry or drupe, with from 1 to 4 minute nuts; embryo in a fleshy albumen.

EXAMPLES.—Lilac (*Syringa vulgaris*), Privet (*Ligustrum vulgare*), Ash (*Fraxinus excelsior*), Olive (*Olea europæa*) Jessamine (*Jasminum officinale*). The *Jasmineæ* have erect ovules, corolla imbricate in æstivation, and of 5 or more divisions. The *Oleaceæ* have pendulous ovules, corolla valvate in æstivation, and of 4 divisions.

ECONOMICAL PROPERTIES.—Olive Oil is the expressed oil of the pericarp of *Olea europæa*, and is the only instance (except Melia) of a fixed oil being procured from the pericarp : fixed oils are almost always contained in the seed. In some parts of Italy the manna which exudes from the *Fraxinus ornus* is used instead of sugar. The Chinese give Tea an aromatic flavour by the leaves of *Olea fragrans*. Oil of Jessamine is the produce of *Jasminum officinale* and *J. grandiflorum*.

MEDICINAL PROPERTIES.—Olive Oil is demulcent and laxative ; it is mostly employed as a vehicle for more active medicines, or for ointments. The leaves are bitter and astringent, and have been recommended as a substitute for bark by M. Bidot. The young capsules of *Syringa vulgaris* are said to be tonic and febrifuge.—*Richard*. The leaves of Common Ash (*Fraxinus excelsior*) have similar properties. Manna is an agreeable laxative, but principally used along with other medicines : it is obtained from the *Fraxinus rotundifolia* as well as from *F. ornus*. The flowers of White Jessamine (*Jasminum officinale*) were formerly

used as antispasmodic; they have an agreeable aromatic perfume.

Officinal Plants.

Olea europæa.
Fraxinus ornus.

ORDER LVIII.

VERBENACEÆ.

Characters.—Trees, shrubs, or herbs, with opposite or whorled leaves, corolla irregular, often bilabiate, stamens 2, or 4 didynamous; ovary 2- or 4-celled, each cell 1-seeded; pericarp a minute capsule, or a drupe or berry, indehiscent, with 2 or 4 cells, each 1-seeded.

Examples. — Vervain (*Verbena officinalis*), Teak-tree (*Tectona grandis*). Vervain is emollient, but scarcely ever used: it was highly prized by the ancients as a remedy for a variety of diseases.

ORDER LIX.

LABIATÆ.

Characters.—Herbs or shrubs, with a quadrangular stem, opposite leaves containing much aromatic volatile oil, and flowers in axillary whorls; calyx monosepalous, tubular, with 5 or 10 teeth or divisions, somewhat bilabiate, persistent; corolla tubular, bilabiate, the upper lip entire or bifid, the lower one 3-

lobed, and larger than the other; stamens inserted in the tube of the corolla, 2, or more often 4 didynamous; ovary deeply 4-lobed, each lobe 1-seeded; style simple, and stigma bifid; a fleshy disk at the base of the ovary; pericarp, consisting of 4 indehiscent acheniums, each 1-seeded, enveloped by the calyx.

EXAMPLES.—Spearmint (*Mentha viridis*), Lavender (*Lavandula spica*), Meadow Clary or Sage (*Salvia officinalis*).

ECONOMICAL PROPERTIES.—All the plants in this family contain an aromatic volatile oil, and many of them are used as condiments or seasonings, as Spearmint (*Mentha viridis*), Thyme (*Thymus vulgaris*), Savory (*Satureia hortensis*), Basil (*Ocymum basilicum*), Sweet Marjoram (*Origanum majorana*). Others also might be used, but these are preferred. Lavender Water, according to M. Richard, is prepared from *Lavandula vera.* Dr Hooker states that Wood Germander (*Teucrium scorodonia*) has been sometimes substituted for Hops: it is very bitter.

MEDICINAL PROPERTIES.—The Labiatæ are characterised by their strong penetrating odour, owing to the volatile oil which exists in almost every part of the plant, and renders them stimulant and carminative, and by a bitter quality dependent on a gum-resinous matter, and which gives them tonic virtues. The latter quality is predominant in Wood Germander (*Teucrium scorodonia*), and in Yellow Bugle (*Ajuga chamæpitys*). Their general character is stimulant and carminative, and a few are deemed antispasmodic, as Pep-

permint (*Mentha piperita*). The oil of Rosemary is frequently used for liniments ; the oil of *Origanum majorana* is very acrid : *Hyssopus officinalis* and *Satureia montana* also are acrid. The following are the plants of this family mentioned by the pharmacopœias : they are not much used.

Officinal Plants.

Mentha viridis.
——— piperita.
——— pulegium (Penny-royal).
Origanum vulgare (Common Marjoram).
———— majorana.
Salvia officinalis (Garden Sage).
Hyssopus officinalis (Common Hyssop).
Lavandula spica.
Marrubium vulgare (White Horehound).
Melissa officinalis (Common Balm).
Rosmarinus officinalis.

There are no poisonous plants among the Labiatæ.

ORDER LX.

BORAGINEÆ.

Asperifoliæ, Linn.

Characters. — Herbs (rarely shrubs) with round stems and alternate leaves, which are covered with stiff hairs, arising from a hard and persistent base. Flowers often in unilateral spikes or racemes; calyx monosepalous, of 5 (seldom 4) divisions more or less

deep, persistent; corolla mostly regular, 5- (rarely 4-) cleft, with imbricated æstivation, often with 5 appendages at the orifice of the tube; stamens inserted in the corolla, of the same number as, and alternate with, its segments; ovary 4-lobed, each lobe or cell 1-seeded, ovules pendulous, style 1, stigma simple or 2-lobed; pericarp sometimes a 4-celled 4-seeded berry or capsule, mostly of 4 acheniums, separate, or united at the base; seed destitute of albumen.

Examples.—Viper's Bugloss (*Echium vulgare*), Borage (*Borago officinalis*), Common Comfrey (*Symphytum officinale*). *Anchusa tinctoria*, *Onosma echioides*, *Lithospermum tinctorium*, and *Echium rubrum*, are used by dyers; their roots are known by the name of *Orcanette.*—*Richard.*

Medicinal Properties.—These are not of much interest. The roots and leaves of the Boragineæ contain a considerable quantity of mucilage; and this seems to be the leading character of the order. Hound's Tongue (*Cynoglossum officinale*) is emollient, and anodyne from a narcotic principle. *Borago officinalis* is emollient and slightly diaphoretic and diuretic; it contains nitrate of potassa. Comfrey (*Symphytum officinale* and *S. tuberosum*) contains mucilage very abundantly. Lungwort (*Pulmonaria angustifolia*) resembles Borage in its properties. Dyers' alcanet (*Anchusa tinctoria*) has a place in the pharmacopœias, but is only used as a colouring matter for oils and ointments.

Officinal Plant.

Anchusa tinctoria.

with imbricated æstivation, and deciduous; stamens generally 5, inserted upon the corolla; ovary simple, 1- or 2-celled, many seeded; style simple or bifid; stigma 2-lobed, or 2 stigmas; pericarp a 1- or 2-celled, many seeded capsule, generally 2-valved, with a central placenta when there are 2 cells, and 2 parietal placentæ where there is only 1 cell.

EXAMPLES.—Centaury (*Erythræa centaurium*), Buckbean or Marsh Trefoil (*Menyanthes trifoliata*), Field Gentian (*Gentiana campestris*).

MEDICINAL PROPERTIES.—Bitterness is the prevailing property of this order; the plants it contains are generally tonic and stomachic. Yellow Gentian (*Gentiana lutea*) is much employed in medicine on account of these valuable qualities: the root is the part used. *G. purpurea* and *G. punctata* possess similar properties, and are used in Germany; and *G. amarella*, *G. cruciata*, *G. campestris*, *Erythræa centaurium*, and *Menyanthes trifoliata* are also bitter, but little used. *Erythræa* is the *Chironia centaurium* of the pharmacopœias; the flowering tops are the parts used, and are deemed antiseptic as well as bitter. *Menyanthes trifoliata* is also reckoned diuretic and purgative; the leaves are the officinal parts. Worm-grass (*Spigelia marilandica*) is purgative and anthelmintic.

Officinal Plants.

Gentiana lutea.
Chironia centaurium.
Menyanthes trifoliata.
Spigelia marilandica.

ORDER LXIV.

APOCYNEÆ.

Apocyneæ and *Asclepiadeæ*, Lindley ; *Strychneæ*, De Cand. ; *Vinceæ*, De Cand.

Characters.—Milky herbs, shrubs, or trees, with opposite or whorled leaves without stipules ; calyx monosepalous, of 5 divisions, persistent ; corolla regular, 5-lobed, sometimes with appendages at the orifice of the tube, deciduous ; stamens 5, inserted upon the corolla, sometimes monadelphous and surrounding the ovary, the anthers close to the stigma ; pollen sometimes pulverulent, sometimes united in masses, occasionally adhering to some projections of the stigma ; ovaries 2 (rarely 1 from the union of the two), many-seeded, with the seeds attached to a longitudinal placenta at the ventral suture of each cell ; styles sometimes united at the apex into 1 stigma, often short ; pericarp a follicle, of which there are 2, or sometimes only 1 (rarely a berry), dehiscing by a longitudinal suture ; seeds with an embryo in a small fleshy albumen, some having an appendage of downy hairs.

This family has been divided into two sections ; the *Asclepiadeæ*, which have the stamens united, the orifice of the corolla with five appendages, and the pollen in masses ; and the true *Apocyneæ*, with the stamens distinct, the orifice of the corolla generally naked, and the pollen pulverulent.

Examples.—1. *Asclepiadeæ* ; Swallow-wort (*Ascle-*

ORDER LXI.

CONVOLVULACEÆ.

Characters.—Herbs or shrubs with slender twining stems, alternate leaves without stipules, and axillary or terminal flowers; calyx of 5 deep divisions, persistent; corolla regular, generally plaited, with the limb entire or 5 lobed; stamens 5, inserted in the lower part of the corolla, and alternate with its lobes; ovary simple, 2 or 4 celled, each cell having a few erect ovules; style simple, or of several divisions; pericarp a capsule 2 or 4 celled, enveloped by the calyx; embryo curved, in a fleshy albumen, and with the cotyledons plaited or shrivelled.

This family is distinguished from the Boragineæ by the plaited corolla, capsular pericarp, and structure of the embryo.

Examples.—Bindweed (*Convolvulus sepium*), Dodder (*Cuscuta epithymum*).

Economical Properties.—The Sweet Potato is the root of *Convolvulus batatas;* it contains an abundant quantity of starch, being used as an article of food, and is destitute of that resinous principle and violent purgative quality which reside in the roots of most of the Convolvulaceæ; the root of *C. edulis* is also edible.

Medicinal Properties.—The valuable properties found in this family reside in the genus Convolvulus.

The roots contain an acrid juice, which, when dried in the sun, furnishes a resinous matter, as in the Scammony (*C. scammonia*), which is a well known and powerful cathartic. The powdered root of Jalap (*C. jalapa*) is another valuable cathartic obtained from this family. Turbith root, obtained from *C. turpethum*, is also a drastic purgative; and M. Richard states that *C. mechoacan*, *C. sepium*, *C. soldanella*, *C. althæoides*, and *C. arvensis*, have similar properties.

Officinal Plants.

Convolvulus jalapa.
Convolvulus scammonia.

ORDER LXII.

BIGNONIACEÆ.

An order of little interest, except for the beauty of their flowers; the Trumpet flower (*Bignonia chica*) is an example. The corolla is irregular, the capsule 2-celled with a central many-seeded placenta, and seeds winged.

ORDER LXIII.

GENTIANÆ.

Characters.—Herbs (rarely shrubs) with opposite sometimes sessile leaves; calyx monosepalous, of 5 divisions, persistent; corolla regular, tubular, of 5 lobes,

Poisonous Properties.—The acrid juice in which the plants of this family abound is, in many cases, extremely poisonous. The leaves, bark, and wood of the Oleander or Rose-bay (*Nerium oleander*) possess an extremely subtile and powerful poisonous principle, which, it is said, has proved fatal to persons who have merely been exposed to the emanations of the tree for some time. The root of *Nerium odorum* is also poisonous. The seeds of *Strychnos nux-vomica* are poisonous in a high degree: the poison seems to exert its action chiefly on the spinal marrow and muscles connected with it, producing locked jaw and tetanus, and spasmodic contractions of the heart and arteries. The active principle is the vegetable alkali Strychnia, which exerts a powerful action on the animal economy even in very small doses. St Ignatius' bean (the fruit of *Strychnos Ignatia*), *S. colubrina*, and the *Upas tieute*, (with which the Javanese poison their arrows), owe their poisonous properties to the presence of Strychnia. The *Upas tieute* is said to be a species of Strychnos. The seed of the Tanghin tree (*Cerebra tanghin*), which grows in Madagascar, is a most powerful poison.

2. PERICOROLLEÆ.

Monopetalous dicotyledonous plants, with perigynous stamens.

65. Styraceæ. 66. Ericineæ.
67. Campanulaceæ.

ORDER LXV.

STYRACEÆ.

Diospyreæ, Rich.

CHARACTERS.—Trees or shrubs, with simple alternate leaves without stipules, and axillary flowers; calyx monosepalous, sometimes entirely free (hypogynous), sometimes united by its base or altogether with the ovary, of 4 or 5 unequal divisions, persistent; corolla imbricate in æstivation, divided; stamens inserted on the corolla, with the filaments sometimes irregularly united by the base; ovary sometimes superior, sometimes inferior or semi-inferior, generally 4-celled (3 or 5), each cell having 2 or 4 ovules, of which half are erect, the others pendulous; style simple, generally with a 4-lobed stigma; pericarp dry or fleshy, enclosed in the calyx, sometimes with 3 or 4 1-seeded cells, or with 1 cell and 1-seeded by abortion; embryo long, contained in a hard or horny albumen.

EXAMPLES.—Benjamin-tree (*Styrax Benzoin*), *Symplocos*, *Alstonia*, Indian Date Plum (*Diospyros*).

MEDICINAL PROPERTIES.—The balsam called Storax, exudes from incisions in the bark of *Styrax officinale:* it consists of resin and benzoic acid, and is expectorant, but little used except for its fragrance. Gum benzoin, which contains a large quantity of benzoic acid, is obtained in a similar manner from *Styrax benzoin*, and is of a similar medicinal character.

pias), *Cynanchum*, Mudar plant (*Calotropis Mudarii*, or *C. gigantea*): 2. *Apocyneæ;* Periwinkle (*Vinca major*), Dog's-bane (*Apocynum*), *Strychnos nux-vomica*, *Urceola elastica*.

Economical Properties.—"We find some nutritious plants in this family; but these are always among the herbaceous species, at an early period of their growth, when the ascending sap, formed of an abundant aqueous juice, has not yet been formed into proper juice by the operation of vegetation. Thus, in some countries, they eat the young shoots of *Periploca esculenta*, *Apocynum indicum*, *Asclepias aphylla*, &c. It is the same with the pulpy fruits of some plants of this family. The greater part of them are acrid and poisonous, but notwithstanding some are very agreeable eating, as the *Couma* and the *Carina edulis* in Nubia, the *Strychnos pseudo-quina* in Brazil."—*Richard*. The pulp of the fruit of *Strychnos nux-vomica* is said to be eaten without any injurious consequences. The Hyahya or Milk-tree of Demerara is the *Tabernæmontana utilis* of this order. Caoutchouc is obtained from it, and abundantly from *Urceola elastica*. *Asclepias lactifera* yields abundantly a milky juice, used as food by some Indians. The Kiriaghuna plant (*Gymnema lactiferum*, or Cow-plant of Ceylon), also furnishes a nutritious milk.

Medicinal Properties.—These are various. Most of the plants in this family contain an acrid milky juice, and furnish valuable medicines in India, Africa, and America. Some are emetic, others purgative,

others bitter and tonic, and some are narcotic. The leaves of *Cynanchum arguel,* or *C. oleæfolium* are often mixed with senna, and they possess similar properties. The concrete juice of *C. monspeliacum* is violently purgative, and is sometimes called Scammony of Montpellier. *Periploca secamone* furnishes Smyrna Scammony. The roots of *C. ipecacuanha* and *Asclepias curassavica* are sometimes used instead of the true Ipecacuanha root. The leaves of Periwinkle (*Vinca major* and *V. minor*) are gently purgative and diuretic. The *Strychnos nux-vomica,* or Rat's-bane, is the only officinal plant in this family. The seeds are the part used, and are powerfully stimulant, exerting their action chiefly on the nervous system. The vegetable alkali strychnia is procured from them, and this is considered the best form for the exhibition of the medicine. In the plant it is in combination with Igasuric acid. St Ignatius' Bean (*S. Ignatia*) is much less active, and has been used in cholera in India. The bark of *S. pseudo-quina* is astringent and bitter, and resembles quassia and gentian : it is much employed as tonic and febrifuge in Brazil. The root of the Yercum or Mudhar plant (*Calotropis gigantea,* or *Asclepias g.*) is much used in India as an alterative, stimulant, and sodorific. Dr Duncan has discovered in it a peculiar principle, which he has called *mudarine.* For a full account of the uses of the various plants in this useful and interesting family, I must refer to Dr Ainslie's Materia Indica.

Officinal Plant.

Strychnos nux-vomica.

Officinal Plants.

Styrax officinale.
Styrax benzoin.

ORDER LXVI.

ERICINEÆ.

Ericineæ and *Vaccineæ*, Richard's Histoire Naturelle Medicale; *Ericæ* and *Rhododendra*, Juss.

Characters.—Arbuscles or shrubs, with alternate, opposite, or whorled leaves, and flowers mostly in spikes or racemes; calyx monosepalous, of 4 or 5 teeth or lobes, sometimes adhering to the ovary (superior), and persistent; corolla regular, of 4 or 5 divisions, (sometimes deep, the corolla appearing polypetalous); stamens 8 or 10, inserted at the base of the perigynous corolla, and having 2 awl-shaped appendages or horns at the base or apex of the 2-celled anthers; ovary sometimes free, sometimes adhering to the calyx, generally of 4 or 5 many-seeded cells, with 1 style and 1 stigma; pericarp a 4- or 5-celled 4- or 5-valved capsule, often accompanied by the calyx, many-seeded, with central placentæ, or a 4- or 5-celled berry, crowned by the teeth of the persistent calyx; seeds minute, with a fleshy albumen.

The true Ericineæ have a superior ovary, and a capsular pericarp. The Vaccinieæ have an inferior ovary (adhering to the calyx), and the pericarp a succulent berry: perhaps the Vaccinieæ might be placed under Epicorolleæ.

Examples.—Ericineæ; the Rhododendrons, Azalea, Winter-green (*Pyrola*), Bearberry (*Arbutus*), Heath (*Erica*): Vaccineæ; Bilberry (*Vaccinium myrtillus*).

Economical Properties.—The use of Cranberries for tarts, &c. is well known; they are the berries of *Vaccinium oxycoccos* (*Oxycoccos palustris*), and *V. macrocarpum*. The Bilberry or Whortleberry (*V. myrtillus*) is much eaten in the Scottish Highlands. The berries of the Strawberry-tree (*Arbutus unedo*) are eaten in some places. In Canada the leaves of *Ledum palustre* are used by the hunters in lieu of tea.—*Dr Hooker.*

Medicinal Properties.—A sharp, sour, or bitter taste, is the characteristic of almost all the organs of the plants which compose the Ericineæ, and they are generally diuretic and astringent. The leaves of Bearbery (*Arbutus uva-ursi*) are tonic, diuretic, and astringent, and contain tannin and gallic acid. The herb of Winter-green (*Pyrola umbellata* or *Chimaphila u.*) is diuretic and tonic, and much used in North America. The leaves of Golden-flowered Rhododendron (*R. chrysanthum*) are astringent and bitter, stimulant and diaphoretic. This, and another species, *R. ferrugineum*, are much used in Russia.

Officinal Plants.

Arbutus uva-ursi.
Pyrola umbellata.
Rhododendron chrysanthum.

Poisonous Properties.—The acridity of *Kalmia latifolia* is so great as to render it poisonous. The honey which bees prepare from the materials they find in the flowers of *Azalea pontica*, is reported, both by ancient and modern authors, to be poisonous. M. Richard also mentions *Ledum palustre* and *Andromeda mariana* as dangerous; *A. ponticum* and *A. maximum* are to be suspected. Ledum is said to be very narcotic.

ORDER LXVII.

CAMPANULACEÆ.

This Order is exemplified in Bell-flower (*Campanula*), Rampion (*Phyteuma*), and Lobelia. It possesses little interest, except for the beauty of some of the species, as Bell-flower. *Lobelia tupa* and several other species are said to be poisonous.

3. EPICOROLLEÆ.

Monopetalous dicotyledonous plants with epignous stamens.

ORDER LXVIII.

COMPOSITÆ.

Synantherece, Rich.—*Syngenesia*, in the artificial system of Linnæus.

Characters.—Herbs or shrubs, with alternate (rarely opposite) leaves, without stipules; flowers very

minute, united in a head or capitulum on a common receptacle, surrounded by an involucre, unisexual or hermaphrodite, sometimes neuter; calyx closely united to the ovary, incorporated with it, and generally terminating in several epigynous hairs or feathers, called *pappus;* corolla ligulate or tubular, with 4 or 5 teeth, generally deciduous; stamens 5, with the filaments distinct, but the anthers united, and forming a hollow cylinder surrounding the style; ovary 1-celled, with 1 erect ovule, and 1 style with a bifid stigma; pericarp an achenium, dry and indehiscent, often crowned by the limb of the calyx expanded into a feathery plume, or consisting of a scaly border.

This very natural and extensive family has been divided into three tribes; the Cynarocephalæ (Carduaceæ, Rich.), Cichoraceæ, and Corymbiferæ.

1. *Cynarocephalæ.*—In this tribe the florets of the capitulum are all tubular *(flosculous):* Thistle (*Carduus*), Artichoke (*Cynara*), are examples.

2. *Cichoraceæ.*—In this tribe all the florets are ligulate (*semi-flosculous*), as in Lettuce (*Lactuca*), Dandelion (*Leontodon*).

3. *Corymbiferæ.*—In this tribe the florets are tubular in the centre, and ligulate in the circumference of the head or capitulum, which is then called radiate; as in Daisy (*Bellis*), Sun-flower (*Helianthus*).

Economical Properties.—These are of little interest in this family. Among the Corymbiferæ we have Jerusalem Artichoke (*Helianthus tuberosus*), the tubers of which form a wholesome article of diet; and Tansy (*Tanacetum vulgare*), the leaves of which have

an agreeable aroma, and are used for seasoning. Among the Cynarocephalæ, we have the Artichoke (*Cynara Scolymus*), the fleshy receptacle of the young flower of which is deemed a luxury. Among the Cichoraceæ, we have Lettuce, a cooling and agreeable salad, the leaves of *Lactuca sativa;* Endive (*Cichorium endivia*) also a favourite salad; and Succory or Chiccory (*Cichorium Intybus*), the leaves of which are used as a salad, and the dried root has been recommended as a substitute for Coffee.

Medicinal Properties.—Bitterness is the leading character of the plants of this family. They are generally tonic and stimulant, and contain a bitter milky principle, the nature of which is little known, and an aromatic volatile oil, sometimes solid and concrete, resembling camphor: this volatile oil is found in greatest abundance in the *Corymbiferæ.* The tribe *Corymbiferæ* contains Common Chamomile (*Anthemis nobilis*), the flowers of which are tonic, stomachic, and even emetic; Pellitory of Spain (*Anthemis pyrethrum*), the root of which is stimulant and sialogogue; Leopard's-bane (*Arnica montana*) a very active medicine, its leaves and flowers being stimulant, diaphoretic, and narcotic, and emetic and cathartic in large doses, while the root is tonic and aromatic; Tartarian Southernwood or Wormseed (*Artemisia santonica*), the tops and seeds of which are tonic and anthelmintic; Common Wormwood (*Artemisia absinthium*), the leaves and tops of which have similar medicinal virtues, and are said also to have a narcotic property; *Artemisia chinensis* and *A. indica*, the downy parts of the leaves of which form the Chinese Moxa;

Elecampane (*Inula helenium*), the root of which is tonic, diuretic, and expectorant; Tansy (*Tanacetum vulgare*), the leaves of which are reckoned tonic and anthelmintic; and Colt's-foot (*Tussilago farfara*), the leaves and flowers of which are demulcent and expectorant. There are only two medicinal plants among the *Cynarocephalæ*, Burdock (*Arctium lappa*), the seeds and root of which are said to be diuretic and diaphoretic, and Blessed Thistle (*Centaurea benedicta* or *Cnicus benedictus*) the leaves of which are tonic, diaphoretic, or even emetic, according to the dose: Common Star Thistle (*Centaurea calcitrapa*) is extremely bitter. The *Cichoraceæ* abound in a milky juice, which is very bitter, and often narcotic. The milky juice of the Garden Lettuce (*Lactuca sativa*) is the *Lactucarium* of the Edinburgh Pharmacopœia, the medicinal properties of which are similar to those of opium. The expressed juice of Strong-scented Lettuce (*Lactuca virosa*) is also powerfully narcotic and diuretic. Dandelion (*Leontodon taraxacum*) is diuretic and aperient. Besides those already mentioned, there are several others used medicinally in some places; they have generally the same properties as the preceding. The leading ones are Bastard Saffron (*Carthamus tinctorius*) which is purgative, and the flowers of which furnish a yellow dye, and also a red dye which is the basis of *rouge;* Milk Thistle (*Carduus marianus*), Common Blue-bottle (*Centaurea cyanus*); Grand Centaury (*C. centaurium*); *Carlina acanthifolia;* Mountain Cudweed (*Gnaphalium dioicum*); Stinking Chamomile (*Anthemis cotula*); Yarrow (*Achillæa millefolium*); *A. ptarmica;* Mugwort (*Artemisia vulgaris*); Wild Cha-

momile (*Matricaria chamomilla*); Butter-bur (*Petasites vulgaris* or *Tussilago P.*); Wild Succory (*Cichorium intybus*); Goat's-beard (*Tragopogon pratense*); Sow-thistle (*Sonchus oleraceus*).

Officinal Plants.

1. *Corymbiferæ.*

Anthemis nobilis.
Anthemis pyrethrum.
Arnica montana.
Artemisia absinthium.
Artemisia santonica.
Artemisia chinensis.
Inula helenium.
Tanacetum vulgare.
Tussilago farfara.

2. *Cynarocephalæ.*

Arctium lappa.
Centaurea benedicta.

3. *Cichoraceæ.*

Lactuca sativa.
Lactuca virosa.
Leontodon taraxacum.

ORDER LXIX.

DIPSACEÆ.

Characters.—This family consists of herbs or shrubs, with opposite or whorled leaves; inflorescence a capitulum, with a common involucre, each flower having an involucellum; calyx adhering to the ovary; 4 or 5 stamens, with the anthers distinct; a 1-celled ovary, with 1 pendulous ovule, 1 style, and a simple stigma.

Examples.—Fuller's Teasel (*Dipsacus fullonum*), and Devil's-bit Scabious (*Scabiosa succisa*) are examples of

this family. The root of the former is said to be tonic and aperient, and its heads or tufts are used for dressing cloth. The root and leaves of the latter are bitter and astringent.

ORDER LXX.

VALERIANEÆ.

Characters.—Herbs with opposite leaves, without stipules; flowers in corymbs or panicles; calyx adherent, often toothed; corolla tubular, inserted into the top of the ovary, with about 5 unequal lobes, and sometimes spurred at the base; stamens 1 to 5, inserted in the corolla; ovary 1-celled, with a solitary pendulous ovule (occasionally 2 other cells, abortive), 1 style, and sometimes a trifid stigma; pericarp dry, indehiscent, 1-celled, crowned by the teeth of the calyx, or by a feathery tuft, and sometimes having 2 empty cells; embryo destitute of albumen.

This family is distinguished from the Dipsaceæ by the want of the involucre, of the albumen in the seed, and by the flowers not being disposed in a capitulum.

Examples.—Valerian (*Valeriana officinalis*), Corn Sallad (*Fedia olitoria*). The Spikenard of the ancients, which has an agreeable flavour, is said to be *Valeriana jatamansi.*

Economical Properties.—*Fedia olitoria* is some-

times cultivated as a sallad, and known by the name of Lamb's Lettuce.

Medicinal Properties.——The root of the Wild Valerian (*Valeriana officinalis*) is stimulant, antispasmodic, and emmenagogue, and much used in nervous diseases. It is also anthelmintic. *V. phu*, *V. dioica*, *V. celtica*, and *V. supina*, have similar properties. *V. officinalis* has received the name of Allheal, from its leaves being frequently employed by the poor as an application to fresh wounds. Cats are very fond of the odour of this plant.

Officinal Plant.
Valeriana officinalis.

ORDER LXXI.

RUBIACEÆ.

Stellatæ, Lindley; *Asperulæ.*

Characters.—Herbs with quadrangular stems, simple and entire whorled leaves, without stipules, and minute flowers; calyx superior, with 4 or 5 lobes; corolla regular, tubular, or rotate, of 4 or 5 lobes, and inserted in the calyx; stamens 4 or 5, inserted on the corolla; ovary 2-celled, each cell having 1 erect ovule, with 1 style and 2 stigmas; pericarp dry and indehiscent (occasionally a berry), 2-lobed, 2-celled, and 2-seeded; embryo in a fleshy or horny albumen.

Examples.—Woodruff (*Asperula odorata*), Bedstraw (*Galium cruciatum*), Madder (*Rubia tinctorum*), which furnishes the *Madder* or *Turkey Red* of dyers. The roots of *Galium verum* and *Asperula tinctoria* also contain a red dye.

Medicinal Properties.—These are of little interest. *Rubia tinctorum* is emmenagogue, but little used in medicine. *Galium verum* has been used to curdle milk for cheese. Squinancy-wort (*Asperula cynanchica*) is somewhat astringent, and has been used for gargles. *A. odorata* is diuretic.

Officinal Plant.

Rubia tinctorum.

ORDER LXXII.

CINCHONACEÆ.

Included in the *Rubiaceæ*, Juss.

Characters.—Trees, shrubs, or herbs, with simple and entire leaves, opposite, and having intermediate stipules; calyx superior, adhering to the ovary, with the limb entire, or with 4 or 5 divisions; corolla regular, tubular, and with 4 or 5 divisions; stamens 4 or 5, inserted on the corolla; ovary with 2 many-seeded cells, or more rarely several 1-seeded or many-seeded cells; ovules, when numerous, attached to a central placenta; style simple, or somewhat divided, with the

stigma also simple or divided; pericarp generally a dehiscent 2-valved capsule, with 2 cells, sometimes a berry, and occasionally many-celled; seed with a hard or horny albumen.

EXAMPLES.—The Coffee-tree (*Coffea arabica*), Ipecacuanha (*Cephaelis Ipecacuanha*), Peruvian Bark (various species of *Cinchona*).

ECONOMICAL PROPERTIES.—Coffee is the roasted seed of the *Coffea arabica*, which belongs to this family. Coffee contains an acid, supposed by some to be *gallic* acid, a peculiar crystallizable principle called *caffein*, and an empyreumatic oil. It is somewhat bitter, but contains an agreeable aroma, and is tonic and exciting. "The fruit of some species of Gardenia, Genipa, and of Vangueria, the Voa Vanga of Madagascar, are succulent and eatable."—*Lindley.*

MEDICINAL PROPERTIES.—This is one of the most important natural families in a medicinal aspect; it contains Cinchona and Ipecacuanha. Coffee also has been used medicinally in intermittent fever and in chronic diarrhœa. Cinchona has long been reckoned a specific in intermittent fever. In general, the plants of this family are bitter and tonic, and some are emetic. There are three species of Cinchona or Quinquina mentioned by the pharmacopœias as furnishing Peruvian Bark, Lance-leaved Cinchona (*C. lancifolia*), which yields the Pale Bark, or Crown Bark; Oblong-leaved Cinchona (*C. oblongifolia*), from which the Red Bark is procured, and Heart-leaved Cinchona (*C. cor-*

difolia), which furnishes the Yellow Bark. Cinchona Bark contains two vegetable alkalis, Cinchonia and Quina, on which its febrifuge properties depend. In the bark these alkalis are in combination with kinic acid. *C. lancifolia* contains Cinchona alone; *C. oblongifolia* contains both Cinchonia and Quina; and *C. cordifolia* Quina alone. Great uncertainty prevails with regard to the exact species from which the various kinds of Peruvian bark are procured; and other genera besides Cinchona are bitter and febrifuge. M. Richard mentions *C. condaminea* and *C. ovalifolia*, besides the species mentioned above. *Exostema caribea* and *E. floribunda* are febrifuge, and called false Cinchonas, but do not contain either Quina or Cinchonia. *Cinchona velozii*, *C. ferruginea*, *C. remijerana*, *Exostema cuspidatum*. *E. australe*, *Buena hexandra*, *Coutarca hexandra*, *Macrocnemum corymbosum*, *Pinckneia pubens*, and several others, furnish a kind of false bark. A bitter and very astringent matter, called Gambeer, is obtained from the leaves of the *Nauclea gambeer:* this is said to be the Kino of druggists.

Ipecacuan root is obtained from *Cephaelis ipecacuanha* (*Calicocca i.*). It contains an active principle, of a peculiar nature, called Emetine. *Psychotria emetica* furnishes the root called Black or Striated Ipecacuan. The roots of *Richardsonia scabra*, *R. emetica*, *Spermacoce poaia*, *S. ferruginea*, and *Manettia cordifolia*, are also emetic. *Chiococca racemosa* is a drastic purgative, and is much used in Brazil.

Officinal Plants.

Cephaelis ipecacuanha.
Cinchona cordifolia.
Cinchona lancifolia.
Cinchona oblongifolia.

ORDER LXXIII.

CAPRIFOLIACEÆ.

Characters.—Trees, shrubs, or herbs, with opposite leaves, without stipules, and the flowers in a cyme or corymb; calyx 4- or 5-cleft, generally with 2 or several bracteæ; corolla 4- or 5-lobed, regular or irregular; stamens 4 or 5; ovary surmounted by an epigynous disk, of 1 or several cells, many-seeded, or 1 of the cells having 1 pendulous ovule; style 1, with 1 or 3 stigmas; pericarp generally fleshy, crowned by the persistent calyx.

The Hederaceæ, containing Hedera and Cornus, are polypetalous, and are made a separate order by some.

Examples.—Elder (*Sambucus nigra*), Woodbine (*Lonicera periclymenum*), Ivy (*Hedera helix*).

Medicinal Properties.—The flowers and berries of the *Sambucus nigra* are diaphoretic and aperient, and the bark and leaves are active purgatives. Dwarf-Elder (*S. ebulus*) is violently purgative. The latter character, and astringency, are the leading features of the Caprifoliaceæ. The flowers of Honeysuckle (*Lonicera caprifolium*) are mucilaginous, and its leaves are astringent. The berries of Ivy (*Hedera helix*) are purgative. In North America *Cornus florida* and *C. sericea* are used as tonic and febrifuge, and as a substitute for Cinchona bark.

Officinal Plant.

Sambucus nigra.

ORDER LXXIV.

LORANTHEÆ.

Characters—Parasitical plants, with a corolla of 4 or 8 divisions, and stamens opposite and equal in number to the divisions, a 1-celled ovary, containing 1 pendulous ovule, with 1 style, and a fleshy pericarp.

Loranthus and Mistletoe (*Viscum*) are examples.

III. POLYPETALEÆ.

Dicotyledonous plants, with a polypetalous corolla.

I. EPIPETALEÆ.

Polypetalous dicotyledonous plants, with epigynous stamens.

75. Umbelliferæ. 76. Araliaceæ.

ORDER LXXV.

UMBELLIFERÆ.

Characters. — Herbs with fistulous stems often furrowed, and alternate sheathing leaves, generally divided or compound; flowers small, white, or yellow, disposed in simple or compound umbels, and generally surrounded by involucres; calyx superior, with the limb absent, entire, or of 5 teeth; petals 5, inserted on a fleshy epigynous disk; stamens 5, alternate with the petals; ovary 2-celled, each cell having 1 pendulous

ovule, styles 2, with a simple stigma; pericarp 2 acheniums (carpels), united by a central axis or columella; seed with a horny or fleshy albumen, generally adhering closely to the pericarp.

This family is distinguished from the Araliaceæ by having only 2 cells in the ovary, and the pericarp dry. The Araliaceæ have several cells, the pericarp succulent, and are often trees or shrubs.

EXAMPLES.—Hemlock (*Conium maculatum*), Carrot (*Daucus carota*), Parsley (*Apium petroselinum*), Parsnip (*Pastinaca sativa*).

ECONOMICAL PROPERTIES.—There are several favourite and useful culinary vegetables in this family, as Parsley (*Apium petroselinum, Petroselinum sativum*, Hooker), Celery (*A. graveolens*), Carrot (*Daucus carota*), Samphire (*Crithmum maritimum*), Parsnip (*Pastinaca sativa*), Earth Nut (*Bunium flexuosum*, and *B. bulbocastanum*). The blanched leaf-stalks of Celery, the leaves of Parsley and Samphire, and the roots of Carrot, Parsnip, and Earth-nut, are the parts used. The leaves and stems in this family are in general dangerous, but the seeds are, for the most part, safe, being warm and aromatic, as in Caraway (*Carum carui*), Coriander (*Coriandrum sativum*). The root of Sweet Fennel (*Anethum fœniculum*) is eaten in some parts of Italy. Garden Beaked-Parsley (*Anthriscus cerefolium* or *Scandix c.*) is a salad and pot herb, known by the name of Garden Chervil. "Candied Angelica, a well known article in confectionary, consists of the prepared stalks of the *Angelica archangelica*."—Hooker. Cow-

parsnip or Hog-weed (*Heracleum sphondylium*) is said to be relished by hogs, and to be wholesome and nourishing for cattle in general.

Medicinal Properties.—There are two principles found in the Umbelliferæ: 1. An aromatic resinous principle, containing a volatile oil, and found chiefly in the seeds; this renders them tonic, stimulant, and carminative, and useful as articles of diet when mixed with much saccharine or mucilaginous matter, as in the Carrot, Parsnip, Parsley, &c.; those which furnish the gum-resins are of the aromatic species: 2. A bitter extractive principle, which gives them the character and properties of narcotic poisons, as we find in Hemlock. The seeds of Dill (*Anethum graveolens*), Sweet Fennel (*A. fœniculum*), Caraway (*Carum carui*), Coriander (*Coriandrum sativum*), Cumin (*Cuminum cyminum*), and Anise (*Pimpinella anisum*), are warm, aromatic, and carminative; they all contain a volatile oil, on which their properties depend. The fruits of Sweet Cicely (*Myrrhis odorata*) "are remarkable for their large size and powerful fragrance; and, as Sir J. E. Smith well observes, make a part of the humble luxuries and simple medicines of the mountain cottager."—*Hooker*. The root of *Angelica archangelica* is deemed an excellent aromatic. The root of *Burnet saxifrage* (*Pimpinella saxifraga*) is diuretic. The seeds of *Œnanthe phellandrium* are aromatic, and regarded as febrifuge, and equal to Peruvian Bark by some. The root of Parsley is diuretic and diaphoretic; and the root of Celery is also diuretic and antiscorbutic. Gum galbanum is the juice which exudes from the stem of Lovage-

ORDER LXXVII.

RANUNCULACEÆ.

Characters.—Herbs (seldom shrubs) with alternate, rarely opposite leaves, generally much divided, and having the petiole dilated and sheathing; calyx of from 3 to 6 sepals, rarely persistent; corolla of 5 or many hypogynous petals, occasionally irregular; stamens many, inserted under the pistils; ovaries many, and often quite distinct, placed on an enlarged receptacle, each with a short lateral style and 1-seeded; occasionally the ovaries are united into 1 many-lobed and many-celled ovary; pericarps dry roots or acheniums, or capsules aggregated together, distinct, or more or less united; seed with a fleshy or horny albumen.

Examples.—Anemone, Buttercup or Crowfoot (*Ranunculus bulbosus*), Monk's-hood (*Aconitum napellus*), Traveller's-joy (*Clematis vitalba*). The leaves of *Ranunculus Ficaria* (Pilewort or Lesser Celandine) are used as a pot-herb in some parts of France, and the seeds of Fennel-flower (*Nigella sativa*) were formerly used as a spice; but the plants in this family are in general dangerous, and always to be suspected.

Medicinal Properties.—The plants in this family are in general acrid and caustic, and some are even poisonous. These properties depend on a very volatile principle, residing in every part of the plant, and easily expelled by boiling, or even by desiccation. The

leaves of Upright Meadow Crowfoot (*Ranunculus acris*), Lesser Spearwort (*R. flammula*), and several other species, are rubefacient, and in some places are used as a vesicatory: the distilled water of the latter is also deemed emetic. *R. bulbosus, R. sceleratus,* and *R. repens,* are also very acrid. The roots, and particularly the unripe fruits, are very acrid in the genus Ranunculus. Pasque-flower Anemone (*A. pulsatilla*) is extremely acrid, and has been recommended by Storck in amaurosis and paralysis. The root of Black Hellebore (*Helleborus niger*) is a powerful purgative and emmenagogue; and the leaves of Bear's-foot or Stinking Hellebore (*H. fœtidus*) are both emetic and cathartic, and were formerly much used as anthelmintic. The seeds of Staves-acre (*Delphinium staphisagria*) are violently emetic and cathartic, and, when chewed, stimulate the salivary glands. The leaves of Monkshood or Wolfsbane (*Aconitum napellus*) are narcotic and diuretic, and also diaphoretic, and have been used in rheumatism, gout, amaurosis, paralysis, &c. It is a very active medicine, and must be administered with great caution.

Officinal Plants.

Ranunculus acris.	Helleborus fœtidus.
Ranunculus flammula.	Delphinium staphisagria.
Helleborus niger.	Aconitum napellus.

Poisonous Properties.—This family is, perhaps, more uniform in its properties than any other in the vegetable kingdom. *Ranunculus acris* is a powerful acrid poison, and causes great irritation and inflamma-

leaved Bubon (*B. galbanum*, *Selinum g.* Spreng.); it contains much volatile oil, and is reckoned antispasmodic and expectorant. Assafœtida is the juice which exudes from the cut root of *Ferula assafœtida*, and is deemed an excellent antispasmodic, expectorant, emmenagogue, and anthelmintic. Gum Ammoniac, an expectorant, antispasmodic, and purgative, is supposed to be the juice of the *Heracleum gummiferum*, belonging to this family. Opoponax is the juice of the roots of *Pastinaca opoponax:* it is antispasmodic and emmenagogue. The leaves and seeds of *Conium maculatum* are powerfully narcotic, and used both externally and internally, to allay pain, &c. The root of the Carrot has been deemed aperient, and the roots of Celery and Parsley also possess this property in a slight degree.

Officinal Plants.

Anethum graveolens.
Anethum fœniculum.
Carum carui.
Coriandrum sativum.
Cuminum cyminum.
Pimpinella anisum.
Angelica archangelica.
Conium maculatum.
Bubon galbanum.
Ferula assafœtida.
Heracleum gummiferum.
Pastinaca opoponax.
Daucus carota.

Poisonous Properties.—Many of the species in this family are extremely poisonous, being narcotic, and very acrid. Hemlock-water Dropwort (*Œnanthe crocata*) is full of a poisonous yellow juice in every part, and serious accidents have resulted from its roots being taken for those of *Bunium bulbocastanum*. Fine-leaved Water-Dropwort (*Œ. phellandrium* or *Phellandrium aquaticum*) is also dangerous. *Conium macula-*

tum is a very active poison, and Fool's Parsley or Lesser Hemlock (*Æthusa cynapium*) is also poisonous, and dangerous, because it is apt to be mistaken for Parsley. Water-Hemlock or Cowbane (*Cicuta virosa*) is a deadly poison.

ORDER LXXVI.

ARALIACEÆ.

This Family differs from the preceding only in having more than 2 cells in the ovary, styles also more than 2, and the pericarp fleshy.

Examples.—Aralia; Ginseng (*Panax quinquefolium*). The root of Panax is valued by the Chinese and Javanese as a tonic and excitant, and is a favourite restorative with them.

2. HYPOPETALEÆ.

Polypetalous dicotyledonous plants with hypogynous stamens.

77. Ranunculaceæ.
78. Magnoliaceæ.
79. Memispermeæ.
80. Rutaceæ.
81. Geraniaceæ.
82. Malvaceæ.
83. Bombaceæ.
84. Byttneriaceæ.
85. Theaceæ.
86. Guttiferæ.
87. Aurantiaceæ.
88. Ampelideæ.
89. Acerineæ.
90. Meliaceæ.
91. Polygaleæ.
92. Fumariaceæ.
93. Papaveraceæ.
94. Nymphæaceæ.
95. Cruciferæ.
96. Cappárideæ.
97. Violarieæ.
98. Caryophylleæ.
99. Lineæ.

more, with 3 or 4 in each row, inserted under the pistils, and early deciduous; stamens often monadelphous, sometimes free, in number equal to the petals, or 2, 3, or 4 times as numerous, but variable; ovaries many, 1-celled, and with 1 style, distinct, or occasionally united into a many-celled ovary; pericarp generally a 1-seeded drupe, somewhat crooked or kidney-shaped; seed of the same form as the pericarp, with no or very little albumen, and a curved embryo.

EXAMPLE.—*Menispermum cocculus.*

MEDICINAL PROPERTIES.—Many of the roots of the plants in this small family contain a bitter principle, and a considerable quantity of starch. Columbo-root, a valuable tonic bitter, is the root of *Menispermum palmatum* or *Cocculus palmatus;* and *M. cordifolium* is similar in its properties. The berries of *M. cocculus,* or Jagged Moonseed (*Cocculus suberosus* or *C. indicus*) have been used in some cutaneous diseases. They are narcotic and poisonous.

Officinal Plants.

Cocculus palmatus.
Menispermum cocculus.

POISONOUS PROPERTIES.—The seeds of *Menispermum cocculus* contain a poisonous principle called *picrotoxine.* They are used to intoxicate fish that they may be caught; and have sometimes been employed to give bitterness to porter and render it more intoxicating.

The seeds of this plant may be ranked among the acro-narcotic poisons.

ORDER LXXX.

RUTACEÆ.

Includes the *Simarubeæ* of some authors.

Characters.—Trees, herbs, or shrubs, with opposite or alternate, simple or pinnate leaves with pellucid glandular dots and without stipules; calyx monosepalous, of 5 (rarely 4) deep divisions; corolla of 4 or 5 petals, sometimes united and forming a kind of monopetalous corolla; stamens about 8 or 10, attached to a hypogynous disk which elevates the ovary; ovary with from 3 to 5 lobes and as many cells, each having 1 or more ovules attached to the internal angle, with a simple style, or divided at the base according to the number of lobes in the ovary, and a simple or 3- to 5-lobed stigma; pericarp of several capsules dehiscing by the summit and internal angle, or a dehiscent capsule with 2, 3 or 5 projecting sides; embryo in a fleshy albumen.

Examples.—Rue (*Ruta graveolens*), *Guaiacum officinale*.

Medicinal Properties.—The plants in this family are in general bitter, acrid and aromatic. The leaves and herbaceous part of Garden Rue (*Ruta graveolens*) are stimulant, antispasmodic, and emmenagogue; they

tion of the intestinal canal, and even death. *Anemone pulsatilla*, *A. nemorosa*, Traveller's-joy (*Clematis vitalba*), *C. recta*, *Helleborus niger*, *H. fœtidus*, *Delphinium staphisagria*, and *Aconitum napellus*, are acrid and extremely virulent poisons. The Biku, Bish, or Vish, of India, one of the most powerful poisons known, is believed to belong to this family, and is referred by some to the genus *Caltha*, by others to *Aconitum ferox*. *A. anthora* and *A. cammarum* are also poisonous. The narcotic principle of *A. napellus* is said by Mr Brandes to be a vegetable alkali, which he has called *aconita*. The seeds of *Delphinium staphisagria* also contain an alkaline principle called *delphinia*, in combination with malic acid.

ORDER LXXVIII.

MAGNOLIACEÆ.

Characters.—Trees or shrubs, with alternate leaves, at first enveloped in 2 large deciduous leafy stipules; flowers large, and with a sweet odour; calyx caducous, of 3 to 6 sepals; corolla of 3 to a great many petals in several rows; stamens numerous, with long anthers inserted below the ovaries; ovaries numerous and distinct, each 1-celled, with 1 ovule or more; a short style, and a simple stigma; pericarps various, dehiscent capsules opening by 2 valves or by a single slit, minute and indehiscent, or sometimes fleshy, distinct or partially united, and set on an elongated receptacle; seeds with a fleshy albumen, containing a small embryo at its base.

Example.—Tulip-tree (*Lyriodendron tulipifera*).

Medicinal Properties.—The Magnoliaceæ are in general aromatic and more or less stimulant, and also bitter and tonic, and the flowers have a strong fragrant odour, which is said in some cases to produce injurious effects. The bark of *Lyriodendron tulipifera* is very bitter, and is much used in North America instead of Peruvian-bark in intermittent fever. *Magnolia glauca* is of a similar nature, and used in North America in intermittent fever and chronic rheumatism, and was at one time supposed to yield Angustura bark. The bark of the Winter's-bark tree (*Wintera aromatica* or *Drymis a.*) is antiscorbutic, and also stomachic and carminative, and is very pungent and aromatic. The seeds of *Illicium anisatum* are highly aromatic and stimulant; these, and the flowers of some other plants in this family, are employed to give an aroma to various liquors, both in Europe and in the West Indies.

Officinal Plant.

Wintera aromatica.

ORDER LXXIX.

MENISPERMEÆ.

Characters.—Twining shrubs, with simple, petiolated, alternate, mucronate leaves, without stipules, minute and generally diœcious flowers; calyx and corolla formed of several sepals and petals, in 1 row or

have a strong aromatic odour, and contain a volatile oil. The wood and resin of *Guaiacum officinale* are stimulant, diuretic, purgative, and diaphoretic. The leaves of Buchu (*Diosma crenata*) are sudorific, diuretic, and tonic, and have a place in the Dublin Pharmacopœia. Cusparia bark or Angustura bark is obtained from *Bonplandia trifoliata* (*Cusparia febrifuga*), and has been recommended in intermittent fever as a tonic: it was formerly supposed to be the produce of *Magnolia glauca*. *Quassia simaruba* and *Q. excelsa*, two well known tonic bitters, belong to this family. Fraxinella (*Dictamnus albus*) has sometimes been used as sudorific and vermifuge. *Evodia febrifuga*, *Ticorea febrifuga*, and *Hortia braziliana* are, according to M. Richard, used in Brazil as substitutes for Cinchona.

Officinal Plants.

Guaiacum officinale.
Ruta graveolens.
Diosma crenata.
Bonplandia trifoliata.
Quassia simaruba.
Quassia excelsa.

ORDER LXXXI.

GERANIACEÆ.

Characters.—Herbs, rarely shrubs, with simple or compound leaves generally opposite; calyx monosepalous, spurred at the base, of 5 deep divisions; corolla of 5 petals, regular or irregular; stamens 5 to 10, sometimes free, sometimes monadelphous; ovary of 3 or 5 projecting lobes with as many cells, having 1, 2 or

more ovules attached to the inner angle; style simple, long, and terminated by 3 or 5 diverging stigmas; pericarp composed of 3 or 5 1-celled indehiscent pieces, with 1 or many seeds, united by a central axis, and separating from each other when ripe, carrying along with them part of the central axis and style; seeds without albumen.

EXAMPLES.—Geranium, Indian Cress or Nasturtium (*Tropæolum majus*), Wood-sorrel (*Oxalis acetosella*).

MEDICINAL PROPERTIES.—Astringency is the prevailing character in this family. This property is very marked in Herb-Robert (*Geranium robertianum*), and in Wood-sorrel (*Oxalis acetosella*). *G. sanguineum*, *G. pratense*, *G. maculatum*, and *Averrhoa bilimbi*, are also acid and astringent. The leaves of Wood-sorrel contain binoxalate of potassa, and are refrigerant, antiseptic, and diuretic. The *essential salt of lemons* is binoxalate of potassa obtained crystallized from the expressed juice of *Oxalis acetosella*. This plant is supposed to be the true *Shamrock* of the Irish. Some are pungent, aromatic, and stimulant, as Indian Cress. This plant is a valuable antiscorbutic, according to M. Richard; the fruits and flowers are used as seasonings.

Officinal Plant.

Oxalis acetosella.

ORDER LXXXII.

MALVACEÆ.

Characters.—Trees, herbs, or shrubs, with alternate leaves accompanied by stipules; calyx of 5 sepals, or monosepalous and of 5 deep divisions, and often closely surrounded by bracteæ, forming a kind of external calyx; corolla generally of 5 petals, often united at the base with the filaments of the stamens and with each other; stamens numerous, monadelphous, sometimes 5 or 10; anthers 1-celled; ovary of several 1- or many seeded carpels somewhat projecting, more or less united, and placed round a common axis, each carpel or lobe 1-celled, and with a simple style; pericarps small nuts or capsules, arranged in a circle or united into a sort of berry; seeds with little or no albumen.

Examples.—Common Mallow (*Malva sylvestris*); *Gossypium herbaceum*, the seeds of which, and of several other species of *Gossypium*, have a hairy or downy covering, which is the Cotton of commerce; *Hibiscus esculentus* (*Ochro* or *Gombo*), the young fruits of which form an article of diet in some countries.

Medicinal Properties.—The plants in this family are of a very mucilaginous nature, and are accordingly mild and demulcent. Marsh Mallow (*Althæa officinalis*), *A. rosea*, *Malva sylvestris*, and *M. rotundifolia*, are useful mucilaginous demulcents, and many exotic

species are used for the same properties, as *Sida cordifolia*, *S. mauritiana*, *Sphæralcea cisplatina*.

Officinal Plants.

Althæa officinalis.
Malva sylvestris.

ORDER LXXXIII.

BOMBACEÆ.

These differ little from the Malvaceæ, except in their stamens arranged in 5 fasciculi, and their ovaries generally of 5 carpels; and they are mostly large trees. They are chiefly remarkable for their great size: the largest tree in the world is the Baobab or *Adansonia digitata*. It contains a great quantity of mucilage, and its fruit is often eaten. It is found in Africa.

ORDER LXXXIV.

BYTTNERIACEÆ.

This family also bears a great resemblance to the Malvaceæ, and is included in the latter by some authors. They are distinguished from the Malvaceæ by having 2-celled anthers, and an ovary of 3 or 5 carpels. In their properties they are similar to the Malvaceæ. *Chocolate* is prepared from the seeds of *Theobroma cacao*, which also contain a thick oily matter, known by the name of *Butter of Cacao*.

ORDER LXXXV.

THEACEÆ.

This family is interesting chiefly on account of the Tea plants (*Thea bohea* and *T. viridis*), and the *Camellias*, which are now so much cultivated on account of the beauty of their flowers, particularly *C. Japonica*. Tea is also the produce of several species of *Camellia*, and other species of *Thea*. They are trees or shrubs, generally with large handsome axillary flowers, numerous sepals, petals, and stamens; one ovary, with 3 or 4 cells, 2 ovules in each cell, and a capsular pericarp of 3 or 4 cells.

ORDER LXXXVI.

GUTTIFERÆ.

Characters.—Resinous trees or shrubs with entire, persistent, opposite leaves without stipules; flowers occasionally unisexual; calyx monosepalous and many-lobed, or polysepalous; corolla of 4 or more petals, passing gradually into sepals; stamens many, unequal in length, distinct, monadelphous or polyadelphous, with the anthers on the lateral part of the filaments; ovary 1- or many-celled, 1- or many-seeded; style and stigma simple, the former sometimes absent; pericarp a dehiscent or indehiscent capsule, or a berry, hard externally, but soft and pulpy internally; seed with no albumen, and with a thin testa.

Example.—The Gamboge tree (*Stalagmitis cambogioides*).

Economical Properties.—The fruits in many of this family contain an agreeable acidulous pulp, as *Mammæa americana*, the Mangosteen (*Garcinia mangostana*), and even those of *Garcinia cambogia* or *Cambogia gutta*, which yields a kind of gamboge.

Medicinal Properties.—Most of the plants in this family contain an acrid, yellow, milky juice, which is powerfully purgative, and almost poisonous. Gamboge, a drastic purgative, is a kind of gum-resin obtained from the bark and young shoots of *Stalagmitis cambogiodes*. *Garcinia cambogia*, and other plants in this family. The *Dryobalanops Camphora*, which is supposed to yield the camphor of Sumatra, has been referred to this family in the dispensatories, but is placed by Blume in a separate order, *Dipterocarpeæ*, with stipules and alternate leaves.

Officinal Plants.

Stalagmitis cambogioides.
Dryabalanops camphora.

ORDER LXXXVII.

AURANTIACEÆ.

Characters.—Trees or shrubs, with alternate leaves, simple or compound, with the petiole often

winged, and abounding in minute vesicles filled with volatile oil; flowers with an agreeable perfume; calyx monosepalous, urceolate, or campanulate, of 4 or 5 lobes or divisions; petals 4 or 5, enlarged at the base, and inserted round a hypogynous disk; stamens occasionally 10, the same number as the petals, or some multiple of that number, placed in the disk, the filaments sometimes united in several fasciculi; ovary many-celled, with a simple style and stigma; pericarp abounding in volatile oil, many-celled and many-seeded, the cells filled with a juicy pulpy matter; seeds solitary in each cell, or numerous, pendulous at the internal angle of the cell, or loosely scattered in the pulp, with no albumen, but thick cotyledons.

Examples.—The Orange (*Citrus aurantium*), the Lemon (*C. medica*).

Economical Properties.—The uses of the Orange, the Lemon, the Citron (a variety of *Citrus medica*), the Lime (*Citrus acida*), and the Shaddock (*Citrus decumana*), are well known. They all contain an agreeable acid, which renders them favourites as dessert fruits, or for making acidulous drinks, for preserves, confectionaries, &c. The rind is generally bitter, and abounds in volatile oil. There are two principal varieties of Orange, the Sweet or China Orange, and the Bitter or Seville Orange. The fruit of the Orange contains malic acid, that of the Lime and Lemon contains a large quantity of citric acid. All the parts of the plants also abound in a fragrant volatile oil. An agreeable distilled water is prepared from the flowers of the Orange

(*Flores naphæ*). Curacoa Oranges are the unripe dried fruit of the same plant.

Medicinal Properties.—The Orange and Lemon are deemed almost specific in scurvy, and they are also much used for refrigerant drinks, and stomachic infusions. The *Acidum Citricum Crystallizatum* of the London Pharmacopœia is prepared from Lemon juice.

Officinal Plants.

Citrus aurantium.

Citrus medica.

ORDER LXXXVIII.

VINIFERÆ.

Vites, *Ampelideæ*, or *Sarmentaceæ*.

Characters.—Trailing or climbing shrubs, supporting themselves by tendrils growing in the place of the peduncles; with simple or digitate alternate leaves, having two stipules at the base, and small greenish flowers, arranged in racemes opposite to the leaves; calyx short; corolla with 4 or 5 petals, placed on a hypogynous disk; stamens opposite, and generally equal in number to the petals; ovary 2-celled, with a short style and simple stigma, each cell generally containing 2 erect ovules; pericarp a pulpy berry, often 1-celled and with from 1 to 5 seeds, with a hard testa, and cartilaginous albumen.

EXAMPLE.— *Vitis vinifera*, the Vine.

ECONOMICAL PROPERTIES.—The grape is the fruit of *Vitis vinifera*, belonging to this family, and the fruits of the other plants which the order contains more or less resemble that of this well-known plant. The leaves are in general acid and astringent. The use of the grape as an article of dessert, either newly gathered, or dried, constituting the raisin, and the use of its juice, for making wine by fermentation, are familiar to every one.

MEDICINAL PROPERTIES.—The leaves of the Vine are somewhat acid and astringent, and have been used in chronic ophthalmia and in diarrhœa. *Verjuice*, a harsh acid juice, is obtained from the unripe grape; it contains bitartrate of potassa or tartar, and malic acid in considerable quantity. When ripe, the grape is deemed antiseptic, diuretic, and aperient. Tartar, an impure bitartrate of potassa, is deposited on the sides of the casks in which the wine is prepared; from this, cream of tartar is prepared. In a medicinal, as well as in an economical, point of view, however, the grape is most valuable on account of the wine which is prepared from it, so useful, and indeed so essential, in diseases of debility, and during convalescence.

Officinal Plant.

Vitis vinifera.

ORDER LXXXIX.

ACERINEÆ.

These are trees with opposite leaves, without stipules, a calyx of 5 divisions, 5 petals, 8 stamens, a 2-lobed and 2-celled ovary, 2 stigmas, and a pericarp composed of 2 winged indehiscent capsules.

Examples.—Greater Maple or Sycamore (*Acer pseudo-platanus*), from the saccharine sap of which a kind of wine is made in some parts of the Highlands; Sugar Maple (*A. saccharinus*), the sap of which furnishes a large quantity of an excellent sugar, much used by the Canadians, and known by the name of *Maple sugar.*

ORDER XC.

MELIACEÆ.

Characters.—Trees or shrubs, with alternate leaves, destitute of stipules; sepals 4 or 5, somewhat united at the base; petals 4 or 5, also cohering at the base, and occasionally unequal; stamens of the same number as, or double the number of, the petals, and monadelphous at the base, and sometimes, in their whole length, forming a tube round the pistil; ovary surrounded at the base by an annular disk, with 4 or 5 cells, 1 or 2 ovules at the internal angle in each cell, 1 style, and a faintly 4- or 5-lobed stigma; pericarp

rarely fleshy, of 4 or 5 cells, each 1- or 2-seeded, and dehiscing by 4 or 5 valves, bearing the dissepiment in the middle of their internal surface.

Examples.—The Mahogany-tree (*Swietenia mahagoni*), Bead-tree (*Melia azedarach*). From the pulpy fruit of *Melia azedirachta*, according to Richard, a thick oil is obtained, used for lamps in India.

Medicinal Properties.—The Meliaceæ are in general aromatic and stimulant. False Winter's Bark, sometimes substituted for that of *Wintera aromatica*, is the produce of *Canella alba*, and is reckoned a good carminative, and in America is valued as an antiscorbutic. The bark of *Swietenia febrifuga* is bitter and febrifuge, and somewhat astringent, and has a considerable resemblance to Kino. The bark of *Swietenia mahagoni* is very astringent, and slightly aromatic. The root of *Melia azedarach* is bitter and nauseous, and is recommended by Drs Barton and Valentin as anthelmintic.

Officinal Plants.

Canella alba.
Swietenia febrifuga.
Swietenia mahagoni.

ORDER XCI.

POLYGALEÆ.

Characters.—Shrubs or herbs, with alternate leaves, without stipules, and flowers in racemes or ter-

minal spikes, generally small, and with 2 or 3 bracteas at the base; calyx of from 3 to 5 sepals, sometimes irregular and unequal, often 3 exterior and 2 interior; corolla of 3 petals, with 1 larger than the other 2, or of 5 petals, with 2 minute, the petals sometimes united at the base; stamens generally 8, and united by the filaments into 2 fasciculi, sometimes 2 or 3 distinct; anthers 1-celled, and dehiscing at the apex; ovary 1- or 2-celled, each cell having 1 pendulous ovule (rarely 2); style and stigma simple; pericarp a minute capsule, sometimes a little fleshy, of 1 or 2 cells, dehiscing by 2 valves; seed pendulous, with a fleshy albumen.

Examples.—Milkwort (*Polygala*), Ratanhy (*Krameria*.)

Medicinal Properties.—The plants in this small family are in general slightly acrid, bitter, and tonic, as *Polygala amara* and *P. senega:* the latter is also a powerful stimulant, and emetic and purgative in large doses. The root of Ratanhy (*Krameria triandria*), contains much astringent matter, and the extract bears a considerable resemblance to kino in its properties and appearance. Ratanhy root " is one of the substances which, in conjunction with gum kino, is used for adulterating port-wine in England."—*Lindley*.

Officinal Plants.

Polygala senega.
Krameria triandria.

ORDER XCII.

FUMARIACEÆ.

An order of little interest, chiefly bitter, tonic, and mucilaginous, as *Fumaria officinalis* or Fumitory, and *Corydalis solida.* The calyx is of 2 sepals, the corolla of 4 petals, the stamens 6 diadelphous, and the ovary 1-celled, with 1 style and a 2-lobed stigma.

ORDER XCIII.

PAPAVERACEÆ.

Characters.—Herbs or shrubs with alternate leaves, flowers in general large and solitary, and a milky juice of a whitish or yellow colour; calyx of 2 concave caducous sepals; corolla of 4 caducous petals arranged in the form of a cross and plaited or wrinkled; stamens numerous, "inserted in 4 parcels, one of which adheres to the base of each petal,"—*Lindley;* ovary 1-celled from the contraction of the dissepiments, and with the placentæ projecting interiorly (parietal); stigma 2-lobed or radiated, sessile; pericarp a 1-celled many-seeded capsule dehiscing by valves or by holes or pores under the permanent stigma, sometimes pod-shaped; seed with a fleshy or oily albumen and a minute embryo.

Examples.—Red Poppy (*Papaver rhœas*), Celandine (*Chelidonium majus*).

Medicinal Properties.—The Papaveraceæ abound in a milky juice of an acrid and narcotic quality, and are in general of a deleterious nature. Opium, the most valuable of narcotics, is obtained from the juice of the leaves, stalks, and capsules of the *Papaver somniferum.* Opium contains three principles different from those found in other vegetables, meconic acid, narcotin, and morphia, a substance of an alkaline nature, and upon which the anodyne property of opium is believed to depend. The *Papaver orientale* is similar in its properties. The petals of the Red Poppy (*Papaver rhœas*) are demulcent and slightly narcotic; they also contain a considerable quantity of red colouring matter, which, according to Dr Duncan, they yield in infusion. The root of Celandine (*Chelidonium majus*) is a drastic purgative, and *Sanguinaria canadensis* is powerfully emetic.

Officinal Plants.

Papaver somniferum.
Papaver rhœas.

Poisonous Properties.—Opium is one of the most powerful narcotic poisons; and the juice of Celandine is an acrid or irritating poison, extremely caustic and violent in its action. *Meconopsis napalensis,* a plant found in Nepal, is also a powerful poison.

These deleterious properties do not exist at all in the seeds of the Papaveraceæ; these contain a considerable quantity of a thick oil of a harmless nature.

ORDER XCIV.

NYMPHÆACEÆ.

An order of little interest in a medicinal point of view, but chiefly remarkable for the beauty of the flowers, and the diversity of opinion which prevails regarding its situation, some placing it among monocotyledonous plants, while others have referred it to the dicotyledonous division. The Nymphæaceæ are aquatic plants, with numerous sepals and petals passing insensibly into each other, many stamens, ovary many-celled and many-seeded, and an indehiscent pericarp. White Water Lily (*Nymphæa alba*), and Yellow Water Lily (*Nuphar lutea*) are examples. They are somewhat astringent, and were formerly deemed anodyne.

ORDER XCV.

CRUCIFERÆ.

Characters.—Herbs with alternate leaves and small yellow or whitish-purple flowers; calyx of 4 sepals, caducous; corolla of 4 petals, deeply clawed, alternate with the sepals, and arranged in a cruciform manner; stamens 6, of which 2 are shorter than the other 4; glands on a kind of disk between the petals and ovary; ovary generally of 2 cells, with a partition formed by the union of 2 elongated parietal placentæ, and with many ovules; style very short; stigma simple or 2-lobed;

pericarp a siliqua or a silicula, dehiscing by 2 valves separating from the dissepiment (seldom 1-celled and indehiscent); seeds pendulous, attached to the placentæ in 4 rows, 2 rows on each side of the dissepiment, and without albumen.

Examples.—Wallflower (*Cheiranthus cheiri*), Cabbage (*Brassica oleracea*).

This is one of the most natural families of plants, both in structure and properties : it is generally divided into two orders, according to the structure of the fruit, the *Siliquosæ* and the *Siliculosæ;* see Figs. 33 and 34, page 106.

Economical Properties.—This is a family of great importance in an economical point of view. Many of them contain a considerable quantity of mucilage, mixed, however, with an acrid principle; when the latter is softened by cultivation they become useful and agreeable articles of food. Their acridity is owing to a volatile principle, which is very fugacious. It is sufficient to mention the names of the leading plants in this family used in domestic economy. The Cabbage (*Brassica oleracea*), of which the White Garden or Heading Cabbage, the Colewort, the Red Cabbage, the Blistered Cabbage or Savoy, the Borcole or Green Kale, the Cauliflower, the Broccoli, and the Brussels' Sprouts, are varieties; Rape (*Brassica napus*), used as a salàd, and the seeds of which contain a large quantity of fixed oil; Garden Rocket (*Brassica eruca*); Turnip (*Brassica rapa*) ; Radish (*Raphanus sativus*) ; Sea-kale (*Crambe maritima*) ; White Mustard (*Sinapis alba*),

ORDER XCVII.

VIOLARIEÆ.

Characters.—Herbs or shrubs with simple leaves, accompanied by 2 stipules; calyx of 5 sepals, somewhat elongated at the point of attachment; corolla irregular, of 5 unequal petals (occasionally regular); stamens 5, alternate with the petals, with short filaments and 2-celled anthers, with the filaments projecting beyond them; anthers almost cohering and closely surrounding the ovary, 2 of the anthers have often a gland at the base; ovary 1-celled, with many seeds attached to 3 longitudinal parietal placentæ; style simple, sometimes curved, with a stigma simple, or swelled and hollowed out into a semicircular depression; pericarp a 1-celled capsule, covered by the calyx, dehiscing by 3 valves bearing the seeds.

Example.—Pansy Violet (*Viola tricolor*).

Medicinal Properties.—The roots of most of the Violarieæ are acrid and nauseous, and are more or less emetic. *Ionidium ipecacuanha* (formerly supposed to furnish the Ipecacuanha of commerce), and *I. parviflorum*, are much used as emetics in Brazil and Peru, and are part of the plants known there under the general name of Ipecacuanha. *Viola odorata*, *V. canina*, *V. tricolor*, and *V. arvensis*, have similar properties. *Emetine*, the peculiar principle which characterises Ipecacuanha, has been found, by M. Caventou, in *V. odorata*. *V. ipecacuanha*, *V. calceolaria*, and *V. itoubou*,

are referred by M. Richard to *Ionidium ipecacuanha*. The flowers of Sweet-scented Violet (*Viola odorata*) have an agreeable perfume, and are used for making a laxative syrup, and also as a test for alkalis and acids. *Viola canina* and *V. arvensis* have been recommended in some cutaneous diseases.

Officinal Plant.

Viola odorata.

ORDER XCVIII.

CARYOPHYLLEÆ.

Characters.—Herbs (rarely shrubs) with entire opposite leaves, often sessile and connate, and the stems enlarged at the joints; calyx often monosepalous, and of 5 teeth, or of 5 distinct sepals; corolla of 5 deeply-clawed petals; stamens 4, 5, or 10, in the latter case, 5 being attached to the petals, and 5 inserted under the ovary; ovary with from 1 to 5 cells, with as many styles and stigmas; pericarp a 1- or 5-celled capsule, dehiscing by 2-5 valves, or by the separation of the teeth at its upper part, rarely fleshy or baccate, with central placentæ bearing many seeds.

Examples.—Maiden Pink (*Dianthus deltoides*), Bladder Campion (*Silene inflata*).

Medicinal Properties.—These are of little interest in this order. The flowers of Clove Gillyflower

the leaves of which are used as a salad; Black Mustard (*Sinapis nigra*), the ground seeds of which constitute a well known condiment; Garden Cress (*Lepidium sativum*), a favourite small salad; Winter Cress (*Barbarea vulgaris*); Water Cress (*Sisymbrium nasturtium*); Scurvy Grass (*Cochlearia officinalis*); Horse Radish (*Cochlearia armoracia*); Charlock (*Sinapis arvensis*), sometimes eaten as turnip-tops; Ladies' Smock (*Cardamine pratensis*), the leaves of which are sometimes used as a salad. Gold of Pleasure (*Camelina sativa* or *Myagrum sativum*), is much cultivated in France for the seeds, which yield a fixed oil much used for lamps. —*Richard.*

Medicinal Properties.—The plants in this family have an acrid or pungent taste, and are generally stimulating and aromatic, being valued in medicine chiefly as antiscorbutic. A pungent volatile oil is found more or less in them all, and in some it is extremely acrid, as in Mustard seed. They are said to contain a quantity of azote or nitrogen, an element more rare in vegetables. Ladies' Smock (*Cardamine pratensis*) is somewhat diaphoretic, and has been recommended in some nervous diseases. Scurvy Grass and Horse Radish (*Cochlearia officinalis* and *C. armoracia*), and Water Cress (*Sisymbrium nasturtium*) are stimulant and diuretic, and deemed antiscorbutic. Mustard seeds, from the *Sinapis alba* and *S. nigra*, are used to stimulate the intestinal canal, and externally for sinapisms.

Officinal Plants.

Siliquosæ.	*Siliculosæ.*
Cardamine pratensis.	Cochlearia armoracia.
Sisymbrium nasturtium.	Cochlearia officinalis.
Sinapis alba.	
Sinapis nigra.	

ORDER XCVI.

CAPPARIDEÆ.

Characters.—Herbs or shrubs, with alternate leaves, sometimes with spinous stipules; calyx of 4 sepals, sometimes united, sometimes irregular; corolla of 4 petals, clawed, arranged in a cruciform manner, and often unequal; stamens numerous (rarely 4 or 6); ovary with a stalk, 1-celled, many-seeded, with a simple filiform style or none; pericarp fleshy, baccate, or siliquose and dehiscent, with many reniform seeds attached to 2 or more parietal placentæ; embryo curved, without albumen.

Examples.—Caper-bush (*Capparis spinosa*), Bastard Mustard (*Cleome icosandra*).

Properties.—In properties this family bears a considerable resemblance to the Cruciferæ, being stimulant, diuretic, and antiscorbutic. The Caper, a well known pickle, is the young flower-bud of *Capparis spinosa.* The bark of the root of this plant is bitter and acrid, and diuretic, and several species of Cleome are used for sinapisms in some countries.

mens, an ovary consisting of 2 carpels, adhering to each other below, but separating above into 2 short styles, rarely 1-celled, and the pericarp a many-seeded 2-valved capsule.

Example.—London Pride, or None-so-pretty (*Saxifraga umbrosa*).

Properties.—This is an order of little interest in a medicinal point of view; it takes its name from the property of breaking down urinary concretions, which White Saxifrage (*Saxifraga granulata*) was formerly supposed to possess. The tubercles of this plant, and most of the plants in the order, are slightly bitter, acrid, and astringent.

ORDER CI.

CRASSULACEÆ.

Sempervivеæ.

Characters. — Succulent herbs, with thick fleshy leaves, which are alternate or opposite; calyx monosepalous, of from 3 to 20 divisions; corolla of as many petals as there are divisions in the calyx, or monopetalous, with many divisions; stamens equal in number to, or twice as many as, the petals, or lobes of the corolla, in the latter case, one half of them being sometimes abortive or transformed into corpuscles of various forms; ovaries the same number as the petals, each 1-celled, and having many ovules attached to a sutural placenta

placed at the internal side; pericarps many-seeded follicles, dehiscing by a longitudinal suture.

Examples.—Stonecrop or Wall Pepper (*Sedum acre*), House Leek (*Sempervivum tectorum*), which contains malic acid.

Properties.—The plants in this family are, in general, somewhat acrid, but sometimes so mild as to be fit for use as articles of diet. Orpine or Stone-crop (*Sedum telephium*) is used as a salad, and the young shoots of White Stone-crop (*Sedum album*), are boiled and eaten in some parts of France. *Sedum acre* is emetic and purgative, and has been recommended as an antiscorbutic.

ORDER CII.

RIBESIEÆ.

Grossularieæ, De Cand.—*Grossulaceæ*, Lindley.

Characters.—Shrubs, generally armed with spines, with lobed alternate leaves, and the inflorescence a spike or axillary raceme; calyx monosepalous, 4 or 5 partite, adhering at its base to the ovary; corolla of 5 small petals, alternate with the divisions of the calyx, and inserted on it; stamens 5; ovary inferior, or semi-inferior, 1-celled, with many ovules, inserted on 2 parietal placentæ, and with a simple or bifid style; pericarp a globular 1-celled, many-seeded, berry, surmounted by the persistent calyx.

Example.—Gooseberry (*Ribes grossularia*).

or Clove Pink (*Dianthus caryophyllus*) are slightly aromatic, stimulant, and diaphoretic, but their only medicinal use is to give colour and flavour to a syrup. *Saponaria officinalis* is slightly bitter and mucilaginous, and has been recommended as a sudorific in gout and cutaneous diseases.

Officinal Plant.

Dianthus caryophyllus.

ORDER XCIX.

LINEÆ.

Characters.—Herbs or shrubs, generally with alternate leaves; calyx generally of 5 sepals, persistent; corolla of 5 petals, clawed; stamens 5 or 10, with the filaments united at the base; ovary with 5 or 10 cells, and as many styles, and 1 ovule at the upper part of the internal angle of each cell; pericarp a globular capsule with many 1-seeded cells, dehiscing by as many valves as there are cells; seeds compressed, and destitute of albumen.

Example.—Flax (*Linum usitatissimum*).

Economical Properties.—The uses of *Linum usitatissimum* are well known: the stems furnish flax, and the seeds furnish linseed-oil, while the cake which remains after the oil has been expressed, is used for fattening cattle, and known by the name of oil-cake.

Medicinal Properties.—Linseed is a valuable emollient and demulcent, and is much employed in medicine for poultices, fomentations, a kind of tea, &c.; the seeds contain a great quantity of mucilage and of a bland fixed oil. The mucilage resides in the testa or episperm, while the oil is found in the kernel or seed. Purging Flax (*Linum catharticum*) is a mild purgative.

Officinal Plants.

Linum usitatissimum.
Linum catharticum.

PERIPETALEÆ.

Dicotyledonous polypetalous plants with perigynous stamens.

100. Saxifrageæ.
101. Crassulaceæ.
102. Ribesieæ.
103. Cucurbitaceæ.
104. Myrtaceæ.
105. Salicareæ.
106. Tamariscineæ.
107. Rosaceæ.
108. Leguminosæ.
109. Terebinthaceæ.
110. Rhamneæ.

ORDER C.

SAXIFRAGEÆ.

Characters.—Herbs with simple alternate leaves, a monosepalous calyx of 4 or 5 divisions, adhering more or less to the ovary, a corolla of 4 or 5 petals inserted between the divisions of the calyx, 5 or 10 sta-

Economical Properties.—This well known family is characterised by the agreeable union of sweetness and acidity found in the berries. They in general contain malic acid. The Red Currant (*Ribes rubrum*) is said to contain also citric acid. There is another species, the Tree Currant (*Ribes spicatum*), which Mr Loudon recommends for cultivation.

The Cacteæ, or Indian Figs, were formerly included in the Ribesieæ, but are now made a separate order, under the name of *Cacteæ* or *Nopaleæ*; they are known by the stamens being indefinite, the calyx and corolla imperceptible, or very minute, and their succulent character. The fruits of many of the Cacteæ are pulpy and refreshing. The milky juice of some of the plants in this family is very dangerous, as in *Cactus grandiflorus*, *C. flagelliformis*, and *C. divaricatus*, but in small doses used medicinally in Saint Domingo. The insect called Cochineal, or *Coccus cacti*, is found upon some species of Cactus, as *C. opuntia*, and *C. cocciferus*.

ORDER CIII.

CUCURBITACEÆ.

Characters.—Herbs with climbing stems, twining, or with tendrils; leaves alternate, petiolated, simple, often deeply divided, and covered with numerous minute tubercles; flowers generally monœcious, occasionally hermaphrodite; calyx monosepalous, of 5 teeth; corolla of 5 petals, or monopetalous of 5 lobes; stamens 5, inserted in the base of the corolla, sometimes distinct, sometimes united, (4 in 2 parcels and 1 free,

or monadelphous); anthers long; ovary inferior, with a short simple or trifid style, terminated by 3 thick glandular stigmas, 1-celled, (rarely 1-seeded), with 6 or many seeds, attached to 3 parietal placentæ; pericarp a pepo (rarely dry and dehiscent), with the seeds scattered in a pulpy matter, and surmounted by the calyx; seeds compressed, with a crustaceous integument, and no albumen.

Example.—Cucumber (*Cucumis sativus*).

Economical Properties.—The pulpy matter found in the fruit of most of the plants in this family is wholesome and often very nutritious, and may be turned to good account as an article of food, or as a pickle. The Melon or Cantaloupe, so much prized as a dessert fruit, is obtained from the *Cucumis melo;* the Common Cucumber is the fruit of the *Cucumis sativus*. Besides these, we have the Pompion (*Cucurbita pepo*), the Water-Melon (*C. citrullus*), the Squash-Gourd (*C. melopepo*), the Warted Gourd (*C. verrucosa*), the Bottle Gourd (*C. lagenaria*), the Orange Gourd (*C. aurantia*), and the Vegetable Marrow Gourd (*C succado*).

Medicinal Properties.—All these fruits are more or less bitter and aperient; in some of this family these properties are highly developed, and it affords some of our most valuable purgatives. The pulp of Coloquintida or Bitter Apple (*Cucumis colocynthis*) is a drastic purgative, and much employed in medicine: its bitterness, according to M. Vauquelin, resides in a resinous principle, which he has called *Colocynthine*. The juice

which surrounds the seeds of the Wild Cucumber (*Momordica elaterium*) affords *Elaterium*, one of the most violent purgatives which we possess. The roots of this plant and of Red-berried Bryony (*Bryonia albà* or *B. dioica*) are also purgative, and the latter is rubefacient when applied to the skin.

The active purgative principle, so abundant in the pulpy matter of the fruits in this family, is not found in the seeds. They are sweetish and mucilaginous, and contain a considerable quantity of a mild fixed oil; they are sometimes used for emulsions. *Jolliffia africana* affords a great quantity of expressed oil, said to be of as good a quality as Olive-oil.

Officinal Plants.

Cucumis colocynthis.
Momordica elaterium.

Poisonous Properties.—In large doses, *Cucumis colocynthis* and *Momordica elaterium* are poisonous. The latter contains *elatine*, which is an extremely active poison.

ORDER CIV.

MYRTACEÆ.

Myrti, Juss.—*Myrtineæ*, Decand.

Characters.—Trees or shrubs, with opposite entire leaves, with numerous transparent glands or dots, and generally persistent; calyx monosepalous, of 4 or 5 divisions, adhering to the ovary; corolla with petals

equal in number to the divisions of the calyx; stamens numerous, distinct, or united by the filaments in several fasciculi; ovary inferior, with 1 to 6 cells, many seeds, and a simple style and stigma; pericarp 1- or many-celled, dry and capsular, or fleshy and baccate, or drupaceous; seed without albumen.

EXAMPLES.—Myrtle (*Myrtus communis*), Clove-tree (*Eugenia caryophyllata*).

ECONOMICAL PROPERTIES.—The plants in this family are in general highly aromatic; they abound in a pungent stimulating volatile oil, which renders many of them valuable as spices. *Cloves* are the unexpanded flower-buds of *Eugenia caryophyllata* (*Caryophyllus aromaticus*); and the unripe berries of the Pimento-tree (*Myrtus pimenta*) constitute *Jamaica pepper* or *allspice*. The Pomegranate is the fruit of *Punica granatum*; it contains an agreeable acid juice.

MEDICINAL PROPERTIES.—This family is characterized by two properties, which render it valuable in a medicinal point of view, astringency, and a warm aroma. The former of these is found in the Pomegranate (*Punica granatum*), the bark and flowers of which are sometimes used in diarrhœa and dysentery, and in the brown Gum-tree (*Eucalyptus resinifera*), which is believed to yield some of the *kino* of commerce. It is not yet decided what plant yields the best or true kino: the Dublin College refer it to the *Butea frondosa*, belonging to the Leguminosæ; the London College adopt *Pterocarpus erinacea* as the source of

kino; while the Edinburgh College give the *Eucalyptus resinifera* as the true source of this gum. The kino imported by the East India Company is the produce of the *Nauclea gambeer*, belonging to the Rubiaceæ.

The Myrtaceæ are valuable as warm carminatives, and even as stimulants. Cajeput oil is the volatile oil obtained from *Melaleuca Leucadendron* and *M. cajeputi;* it is a very powerful local and general stimulant. *Myrtus pimenta* and *Eugenia caryophyllata* are valued as carminatives.

Officinal Plants.

Punica granatum.	Myrtus pimenta.
Eucalyptus resinifera.	Melaleuca leucadendron.
Eugenia caryophyllata.	Melaleuca cajeputi.

ORDER CV.

SALICARIÆ.

Characters.—Herbs with opposite leaves; a monosepalous, tubular, toothed, or lobed calyx; deciduous petals placed between the lobes of the calyx; stamens often the same number as the petals, and inserted below them on the calyx; a 2- or 4-celled ovary, with a simple style and stigma, and many seeds; a capsular dehiscent pericarp, generally 1-celled, and covered by the calyx, and the seeds adhering to a central placenta.

Example.—Purple Loosestrife (*Lythrum Salicaria*).

Medicinal Properties.—The herb of *Lythrum Salicaria* is mucilaginous and astringent, and was formerly much employed in diarrhœa. The leaves of *Ammannia vesicatoria* are extremely acrid, and, according to Dr Ainslie, are much employed in India as blisters, being simply bruised and applied to the skin.

Officinal Plant.

Lythrum Salicaria.

ORDER CVI.

TAMARISCINEÆ.

Characters.—Shrubs or herbs, with alternate leaves; a persistent calyx of 4 or 5 divisions; a corolla of as many petals; about 5 or 10 stamens; a superior ovary, with a short style and 3 stigmas; and a 1-celled, many-seeded, 3-valved capsule, with 3 placentæ.

Example.—*Tamarix gallica*, which produces a very pure kind of sugar called the Manna of Mount Sinai.

ORDER CVII.

ROSACEÆ.

Rosaceæ, Pomaceæ, Amygdaleæ (Drupaceæ), and *Sanguisorbeæ,* Lindley.

Characters.—Trees, shrubs, or herbs; leaves alternate, simple, or compound, often pinnate or digi-

tate, and with 2 stipules often joined laterally; inflorescence very various; flowers generally white, seldom red or yellow; calyx monosepalous, tubular or spread out, sometimes accompanied by an external second calyx, of 5 divisions or lobes; corolla of 5 equal petals, inserted in the orifice of the tube of the calyx, or at the base of the divisions; stamens numerous; pistils 1 or many, sometimes distinct, sometimes united into a many-celled ovary, sometimes many placed on the walls of a tubular calyx, often placed on an enlarged receptacle; each ovary 1-celled, with 1, 2, or a small number of ovules; style often lateral, or arising from the base of the ovary; pericarp a drupe, a pome, or an achenium.

This extensive family is divided into six sections; the Fragariaceæ, the Spiræaceæ, the Agrimoneæ, the Amygdaleæ or Drupaceæ, the Roseæ, and the Pomaceæ.

1. *Fragariaceæ.*—These have compound leaves, a spreading calyx, numerous pistils set on a gynophore, which sometimes becomes fleshy, and in the fruit numerous acheniums or drupes, in a sort of capitulum or head; as Fragaria, Potentilla, Geum, Rubus.

2. *Spiræaceæ.*—These have a fruit composed of from 3 to 12 capsules or follicles, dehiscing by 2 valves; as Spiræa.

3. *Agrimoneæ.*—These have a tubular calyx with 1 or several pistils, and fruit composed of 1 or several acheniums, contained in the tube of the calyx; as in Agrimonia.

4. *Drupaceæ.*—These are characterized by the fruit being a fleshy drupe, containing 1 nut of 2 seeds, or,

from abortion, with only 1 seed; as Prunus, Amygdalus.

5. *Roseæ.*—These have a tubular urceolate calyx, which becomes fleshy, and contains many parietal bodies, which are the true ovaries; as Rosa: See Fig. 28, page 89.

6. *Pomaceæ.*—In this section the pistils are from 2 to 5, united with each other and the tube of the calyx, and the pericarp is a pome.

Economical Properties.—The fruits of many of the plants in this family contain a considerable quantity of saccharine matter, mixed with malic acid, and are much esteemed. The following are the principal kinds: the Strawberry (*Fragaria vesca*), the Musky or Hautboy (*F. elatior*), the Raspberry (*Rubus idæus*), the Bramble (*R. fruticosus*), the Cloudberry (*R. chamæmorus*), the Dewberry (*R. cæsius*), the Stone Bramble (*R. saxatilis*), the Plum (*Prunus domestica*), the Cherry (*P. cerasus*), the Gean (*P. avium*), which contains prussic acid; the Apricot (*P. armeniaca*), the Sloe (*P. spinosa*), which makes an excellent preserve; the Peach (*Amygdalus persica*), of which the Nectarine is a variety; the Sweet and Bitter Almond (*Amygdalus communis* and *A. amara*), the Apple (*Pyrus malus*), the Quince (*P. cydonia*), the Pear (*P. communis*), the Service (*P. domestica*), the Medlar (*Mespilus germanica*), the Loquat Apple (*M. japonica*). Besides these, there are many others capable of forming good edible fruits when cultivated. *Prunus armeniaca*, *P. domestica*, and *Amygdalus communis*, furnish a kind of gum, which exudes from the trunk and branches.

Medicinal Properties.—These are various in this extensive family. In the Fragariaceæ, Agrimoneæ, and Spireaceæ, there is a considerable degree of bitterness and astringency, as in the roots of the Strawberry (*Fragaria vesca*), which contain tannin and gallic acid; the roots of Silver-weed (*Potentilla anserina*); the whole plant of *Tormentilla erecta*, which has been sometimes used for tanning; Herb-Bennet (*Geum urbanum*), which was formerly in use as a febrifuge; the root of Meadow-Sweet (*Spiræa ulmaria*); the leaves of Agrimony (*Agrimonia eupatoria*), which are used for gargles; the petals of Red Rose (*Rosa gallica*), and the fruit of *R. canina*, which are used for conserves, &c. The Bitter Almond (*Amygdalus amara*) and the Sweet Almond (*A. communis* or *A. dulcis*) yield, by expression, a bland oil much used for emulsions. The flavour of the Bitter Almond is owing to the presence of prussic acid, which is not found in the Sweet Almond, or at least in very small quantities. "The bland oil, called almond oil, is obtained from Bitter as well as Sweet Almonds, by expression, if no heat be employed; but if heated, the oil expressed from Bitter Almonds is impregnated more or less with the narcotic volatile oil, as is readily manifested by its smell and taste."—*Dr Duncan.* Prunes, the dried fruit of *Prunus domestica*, are considered a mild laxative. Quince seeds, from the *Pyrus cydonia*, are supposed to have the power, in small doses, of repressing vomiting: they are very acid. The fruit of the Dog-rose (*Rosa canina*) is said to contain citric acid. The petals of the Damask-rose (*R. centifolia*) are used for distilling rose-water. *Brayera anthelmintica* is said to be almost specific against tænia; it is an Abyssinian plant, and is much used at Constantinople.

Officinal Plants.

Fragariaceæ.	*Roseæ.*
Geum urbanum.	Rosa gallica.
Tormentilla erecta.	Rosa centifolia.
Agrimoneæ.	Rosa canina.
Agrimonia eupatoria.	*Pomaceæ.*
Drupaceæ.	Pyrus Cydonia.
Amygdalus communis.	
Amygdalus amara.	
Amygdalus persica.	
Prunus domestica.	
Prunus Lauro-cerasus.	

Poisonous Properties.—The Drupaceæ contain a considerable quantity of prussic acid in the leaves and in the seeds, and some of them are dangerous on this account. The *Cerasus capricida* proves fatal to goats which feed upon its leaves; the leaves of Cherry-laurel (*Prunus lauro-cerasus*) afford prussic acid by distillation; and this acid may also be detected in Peach blossoms and leaves, and in the bark of the Bird-cherry (*Prunus padus*). Bitter Almonds are dangerous in any considerable quantity, and their essential oil is highly poisonous.

ORDER CVIII.

LEGUMINOSÆ.

Papilionaceæ.—Tournefort.

Characters.—Trees, shrubs, or herbs, with alternate generally compound leaves (rarely simple), digi-

tate, pinnate, biternate, or bipinnate, and with 2 persistent stipules at the base of each petiole and leaflet; flowers solitary, in racemes or in panicles;—1. sometimes they are irregular and *papilionaceous*, that is, with a tubular calyx, toothed at the summit, a corolla formed of 5 unequal and irregular petals (see par. 281), and 10 stamens, generally diadelphous, seldom free or monadelphous;—2. sometimes the flower is more regular, being composed of a calyx of 5 deep divisions, an equal and regular polypetalous corolla of 3 to 5 petals, and 10 free stamens, of which several are often abortive;—3. sometimes there is a calyx of 5 teeth, (corolla), accompanied by an external calyx, with no corolla, and numerous stamens, free or monadelphous:—ovary superior, 1-celled, generally many-seeded, with a simple style and stigma; pericarp a drupe or legume, generally the latter; the legume is most frequently 1-celled, many-seeded, and dehiscing by 2 valves; but it is sometimes of several cells, and jointed, dehiscing at the articulations.

This very natural family has been divided into three sections, the Papilionaceæ, Cassiæ, and Mimosæ.

1. *Papilionaceæ.*—These are characterized by the papilionaceous corolla, and have in general 10 diadelphous stamens, as Broom (*Spartium scoparium*), Pea (*Pisum sativum*), Laburnum (*Cytisus laburnum*).

2. *Cassiæ.*—These have an equal and regular corolla of 3 or 5 petals, and 10 stamens, of which some are frequently abortive, as the Senna shrub (*Cassia senna*), the Tamarind tree (*Tamarindus indica*).

3. *Mimosæ.*—These have a double calyx, the exter-

nal small and of 5 teeth, the internal monosepalous and tubular (sometimes called corolla), and numerous stamens generally monadelphous, as the Sensitive plant (*Mimosa pudica*), the Gum tree (*Acacia vera*).

Regarding this order, Mr Lindley observes : " The most common feature is, to have what are called papilionaceous flowers ; and when these exist, no difficulty is experienced in recognising the order, for papilionaceous flowers exist no where else. Another and a more invariable character is to have leguminous fruit ; and by one of these two characters all the plants of the family are known."

Economical Properties.—To man this is one of the most important families in the vegetable kingdom; indeed, with the exception of the Gramineæ, there is no one which furnishes, directly or indirectly, so many of the necessaries of life. Many are useful as food for man, but they are more important as furnishing excellent pasture for cattle. It contains the Pea (*Pisum sativum*), the Bean (*Vicia Faba*), the Kidney Bean or Haricot (*Phaseolus vulgaris*) ; Dyers' Green-weed (*Genista tinctoria*), used to dye a yellow colour ; St John's Bread (*Ceratonia siliqua*), the fleshy fruit of which is used as an article of food in the countries where the tree is common ; Saintfoin (*Onobrychis sativa* or *Hedysarum onobrychis*) ; White Trefoil or Dutch Clover (*Trifolium repens*), Common Clover (*T. pratense*), Black Medick or Nonsuch (*Medicago lupulina*), Lucerne (*M. sativa*), the South American Earth-nut (*Arachis hypogea*), used as food in New Spain. The leaves of *Indi-*

gofera anil, *I. tinctoria*, and *I. argentea*, yield indigo, a valuable blue dye. The Tamarind, a pleasant acid fruit, is the produce of *Tamarindus indica*.

Medicinal Properties.—In a medicinal point of view this is a very important family. It affords the valuable purgative Senna, which consists of the leaves of *Cassia obovata*, *C. acutifolia*, and *C. lanceolata;* the fruit and pulp of another species of Cassia, *C. fistula*, and the pulp of the Tamarind (*Tamarindus indica*), are gently laxative. The stiff hairs of the pod of Cow-itch (*Dolichos pruriens*) are used as anthelmintic. Tamarinds contain sugar, and citric, malic, and tartaric acids. The bark of the Cabbage-tree (*Geoffræa inermis*) is a powerful anthelmintic. *Genista tinctoria* is purgative, and in some parts of Russia deemed a specific in hydrophobia. Fenugric seeds, from the *Trigonella phœnum-grœcum*, are emollient, and employed in veterinary medicine. The leaves of Bladder-Senna (*Colutea arborescens*) are employed as a purgative, and often mixed with Senna leaves. The Leguminosæ also contain some valuable astringents, as Catechu, or Terra Japonica, obtained from the wood of *Acacia catechu;* and the barks of *A. vera*, and of most other species which furnish gum, are highly astringent, and used for tanning in some parts of India. Gum Kino is said to be obtained from *Pterocarpus erinacea*. Saunders-wood, from the *P. santalinus*, contains a red colouring matter, used in dyeing. Dragon's-blood, obtained from the *P. draco*, has been deemed astringent, but, according to Dr Duncan, is a pure resin, without any astringency. Logwood, the wood of *Hæmatoxylon campechi-*

anum, is somewhat astringent, but used chiefly as a dye. The tops and seeds of Broom (*Spartium scoparium*) are diuretic. Many trees in this family furnish a highly nutritious gum, valuable in medicine as a pectoral. The well known substance, Gum Arabic, is obtained from *Acacia vera* and *A. arabica.* Gum Tragacanth is the produce of *Astragalus tragacanthus*, *A. verus*, *A. gummifer*, and *A. creticus.* Some valuable balsams are found among the Leguminosæ, as Copaiva, from the *Copaifera officinalis*, Balsam of Peru, from the *Myroxolon peruiferum*, and Balsam of Tolu, from the *M. toluiferum* or *Toluifera balsamum.* The mild saccharine and mucilaginous substance, called Liquorice, is the extract of *Glycyrrhiza glabra.* Lac is the produce of *Erythrina monosperma ;* and Gum or Resin Anime, of *Hymenea courbaril :* they are used for varnishing.

Officinal Plants.

Papilionaceæ.

Astragalus tragacanthus.
Astragalus creticus.
Astragalus verus.
Glycyrrhiza glabra.
Pterocarpus draco.
Pterocarpus santalinus.
Pterocarpus erinacea.
Copaifera officinalis.
Myroxolon peruiferum.
Myroxolon toluiferum.
Geoffræa inermis.
Dolichos pruriens.
Spartium scoparium.

Cassiæ.

Cassia fistula.
Cassia senna.
Hæmatoxylon campechianum.
Tamarindus indica.

Mimosæ.

Acacia vera.
Acacia arabica.
Acacia catechu.

Poisonous Properties.—The seeds of the Laburnum (*Cytisus laburnum*) are said to be poisonous, owing to the presence of a peculiar uncrystallizable principle, called *Cytisine*; and a few other plants in the order are deemed dangerous.

ORDER CIX.

TEREBINTHACEÆ.

Characters.—Trees or arbuscles, with alternate leaves without stipules, and generally compound; flowers minute, in branched racemes, hermaphrodite or unisexual, monœcious or diœcious; calyx monosepalous, of 3 to 5 deep divisions; corolla of 5 petals, or absent; stamens of the same number, or twice as many as the petals, inserted along with the petals on a perigynous disk; ovary simple and superior, 1-celled and 1-seeded, or many-celled; style simple and short, with a 3-lobed stigma, or 3 stigmas; pericarp a dry or succulent drupe, with one 1-seeded nut, or several small nuts.

Examples.—Balm of Gilead Tree (*Amyris gileadensis*), Poison Oak (*Rhus toxicodendron*), Cashew Nut (*Anacardium occidentale*), Mango Tree (*Mangifera indica*), which has a wholesome agreeable fruit.

Medicinal Properties.—This family abounds in balsams. Balsam of Gilead is the resinous juice of *Amyris gileadensis;* Opobalsam, or Balm of Mecca, of (*A. opobalsamum*). Elemi is the produce of *Amyris*

elemifera, or *Icica Icicariba.* Olibanum, said to be the Frankincense of the ancients, is obtained from *Boswellia serrata;* Chian turpentine, from the *Pistacia terebinthinus;* Mastich, used to preserve the teeth, and strengthen the gums, from the *Pistacia lentiscus;* and Copal, from the *Rhus copallinum.* The seeds of *Pistacia vera* contain a large quantity of a mild fixed oil, and may be used for emulsions. Myrrh is said to be the produce of *Amyris kataf.* Resin acouchi is obtained from *Icica acuchi*, and Resin chibon from *Bursera gummifera.* The leaves of Sumach or Poison Oak (*Rhus toxicodendron*) have been recommended in paralysis, and operate as a gentle laxative; applied to the skin they are extremely irritating, and produce erysipelas. They are full of a whitish resinous juice, and are extremely acrid.

Officinal Plants.

Amyris elemifera.	Pistacia terebinthus.
Amyris gileadensis.	Pistacia lentiscus.
Boswellia serrata.	Rhus toxicodendron.

Poisonous Properties.—There are several plants of a dangerous nature in this family, as *Rhus toxicodendron,* which is extremely irritating, and may be ranked among the acrid poisons; *Amyris toxifera;* and *Brucea antidysenterica* (formerly supposed to furnish Angustura Bark), which contains an alkali, Brucia, similar to Strychnia, but not so powerful in its action. Some of the varnishes which are obtained in this order are dangerous when they come in contact with the skin.

The leading or diagnostic character of the first 11 Classes is taken from the number of stamens. They are as follows:

1. MONANDRIA,	with	1 stamen, ...	Amomum zingiber, *Ginger.*
2. DIANDRIA,	...	2 stamens, ...	Olea europæa, *Olive.*
3. TRIANDRIA,	...	3	Valeriana officinalis, *Valerian.*
4. TETRANDRIA,	...	4	Dorstenia contrajerva.
5. PENTANDRIA,	...	5	Atropa Belladonna, *Nightshade.*
6. HEXANDRIA,	...	6	Aloe spicata.
7. HEPTANDRIA,	...	7	Æsculus hippocastanum, *Chestnut.*
8. OCTANDRIA,	...	8	Daphne mezereum, *Spurge Laurel.*
9. ENNEANDRIA,	...	9	Rheum palmatum, *Rhubarb.*
10. DECANDRIA,	...	10	Cassia senna.
11. DODECANDRIA,	...	11 to 19 ...	Asarum europæum, *Asarabacca.*

The next 2 classes are characterized partly by the situation and partly by the number of the stamens:

12. ICOSANDRIA,...20 or more stamens inserted into the calyx (perigynous), ...	Amygdalus communis, *Sweet Almond.*
13. POLYANDRIA,...20 or more stamens inserted under the ovary (hypogynous), ...	Papaver somniferum, *Opium Poppy.*

The next 2 classes are characterized by the number and proportional length of the stamens:

14. DIDYNAMIA,...4 stamens, 2 long and 2 short, ...	Digitalis purpurea, *Purple Foxglove.*
15. TETRADYNAMIA,...6 stamens, 4 long and 2 short, ...	Cochlearia officinalis, *Scurvy-grass.*

The stamens are united by their filaments into fasciculi or bundles in the next 3 classes, which are characterized by the number of these fasciculi:

16. Monadelphia,...stamens united in 1 fasciculus or tube,.........	Althæa officinalis, *Marsh Mallow.*
17. Diadelphia,...stamens united in 2 fasciculi,.........................	Dolichos pruriens, *Cow-itch.*
18. Polyadelphia,...stamens united in 3 or more fasciculi,...........	Citrus aurantium, *Orange.*

In the next class the stamens are united by their anthers:

19. Syngenesia,...anthers united,	Anthemis nobilis, *Chamomile.*

In the next class the stamen and pistil are united:

20. Gynandria,...stamen and pistil united,...............................	Aristolochia serpentaria, *Snake-root.*

In the next 3 classes the flowers are unisexual:

21. Monœcia,...unisexual flowers growing on the same plant,.......	Ricinus communis, *Castor-oil Plant.*
22. Diœcia,...the male and the female flowers growing on different plants,.................................	Humulus lupulus, *Hop.*
23. Polygamia,....hermaphrodite, male, and female plants, growing on the same plant or on separate plants,................................	Ficus carica, *Fig.*

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24. Cryptogamia,...... flowerless plants,...................................	Lichen islandicus, *Iceland Moss.*

ORDER CX.—

RHAMNEÆ.

Characters.—Trees or shrubs, with simple opposite or alternate leaves, generally accompanied by small stipules, and small flowers; calyx monosepalous, with 4 or 5 divisions; corolla of 4 or 5 petals, inserted in the calyx, sometimes absent; stamens of the same number as the petals, often inserted on a perigynous disk; ovary generally superior, of 2, 3, or 4 cells, each with 1 ovule (rarely 2); style simple, sometimes divided at the summit, and with as many stigmas as there are cells in the ovary; pericarp sometimes dry and capsular, dehiscing by 3 valves, sometimes fleshy; seed with an erect embryo and a fleshy albumen.

Example.—Purging Buckthorn (*Rhamnus catharticus*), the berries of which, when prepared with gum-arabic and lime-water, yield a green dye.

Medicinal Properties.—The berries of *Rhamnus catharticus* are bitter and nauseous, and act as purgatives, and other species act in a similar way, as *R. frangula*, *R. infectorius*. *Ceanothus americanus* and *Prinos verticillatus* have leaves and bark very bitter and astringent, and in some places are used as tonics. The fruit of the Jujube (*Ziziphus vulgaris*) is of a very different character, being of a mild and saccharine nature, and employed as pectoral.

Officinal Plant.

Rhamnus catharticus.

VIEW

OF THE

LINNÆAN SYSTEM

FOR THE

CLASSIFICATION OF PLANTS.

In this arrangement there are 24 Classes. The first 23 include the Flowering or Phænogamic Plants. They have, in general, a calyx and corolla, and always stamens, pistils, and seeds consisting of radicle, gemmule, and cotyledons. They correspond to the Cotyledoneæ of Jussieu, the Vasculares of Decandolle, and the Embryonatæ of Richard.

The 24th Class consists of the Flowerless or Cryptogamic Plants. They are destitute of stamens, pistils, calyx, corolla, and have simple seeds (sporules), destitute of radicle, gemmule, and cotyledons. They correspond to the Acotyledoneæ of Jussieu, the Cellulares of Decandolle, and the Exembryonatæ or Ahrizæ of Richard.

In the 23d class, Polygamia, there are 3 orders:

1. *Monœcia,* in which one plant may have perfect flowers and male flowers, perfect flowers and female flowers, or perfect, male, and female flowers, ...	Veratrum album, *White Hellebore.*

2. *Diœcia,* in which the several kinds of flowers are found on 2 plants.

3. *Triœcia.* In this order the different kinds of flowers are placed on 3 different plants, as in the Fig-tree (*Ficus*), ...	Ficus carica, *Fig.*

In the 24th class, Cryptogamia, the orders have been somewhat modified since the time of Linnæus: see page 173.

The following table will give a clear view of the principles upon which the classes and orders are founded in the system of Linnæus.

				CLASSES.	ORDERS.
SEXUAL ORGANS PRESENT.	FLOWERS HERMAPHRODITE.	*Stamens distinct from the pistil.* Stamens distinct from each other.	1 stamen	1. MONANDRIA	Monogynia, Digynia.
			2 stamens	2. DIANDRIA	Monogynia, Digynia, Trigynia.
			3	3. TRIANDRIA	Monogynia, Digynia, Trigynia.
			4	4. TETRANDRIA	Monogynia, Digynia, Tetragynia.
			5	5. PENTANDRIA	Monogynia, Digynia, Trigynia, Tetragynia, Pentagynia, Polygynia.
			6	6. HEXANDRIA	Monogynia, Digynia, Trigynia, Tetragynia, Hexagynia, Polygynia.
			7	7. HEPTANDRIA	Monogynia, Digynia, Tetragynia, Heptagynia.
			8	8. OCTANDRIA	Monogynia, Digynia, Trigynia, Tetragynia.
			9	9. ENNEANDRIA	Monogynia, Trigynia, Hexagynia.
			10	10. DECANDRIA	Monogynia, Digynia, Trigynia, Pentagynia, Decagynia.
			11 to 19	11. DODECANDRIA	Monogynia, Digynia, Trigynia, Tetragynia, Pentagynia, Dodecagynia.
			20 or more stamens on the calyx	12. ICOSANDRIA	Monogynia, Pentagynia, Polygynia.
			... receptacle	13. POLYANDRIA	Monogyn., Digyn., Trigyn., Tetragyn., Pentagyn., Hexagyn., Polygyn.
			2 long and 2 short	14. DIDYNAMIA	1. Gymnospermia, seeds naked. 2. Angiospermia, seeds in a seed-vessel.
			4 long and 2 short	15. TETRADYNAMIA	1. Siliculosa, pericarp a silicula. 2. Siliquosa, pericarp a siliqua.
		Stamens united to each other	By the filaments: In 1 fasciculus	16. MONADELPHIA	Triandria, Pentandra, Heptandria, Octandria, Decandria, Endecandria, Dodecandria, Polyandria.
			By the filaments: In 2 fasciculi	17. DIADELPHIA	Pentandria, Hexandria, Octandria, Decandria.
			By the filaments: In several fasciculi	18. POLYADELPHIA	Dodecandria, Icosandria, Polyandria.
			By the anthers	19. SYNGENESIA	1. Polygamia Æqualis, all the florets hermaphrodite. 2. .... Superflua, florets of the disk hermaphrodite, of the ray female. 3. .... Frustranea, florets of the disk hermaphrodite, of the ray neuter. 4. .... Necessaria, florets of the disk male, of the ray female. 5. .... Segregata, each floret with a separate flower-cup, or calyx.
		Stamens united with the pistil		20. GYNANDRIA	Monandria, Diand., Triand., Tetrand., Pentand., Hexand., Octand.
	FLOWERS UNISEXUAL	Male and female flowers on the same plant		21. MONŒCIA	Monandria, Diand., Triand., Tetrand., Pentand., Hexand., Polyand., Monadelphia, Polyadelphia.
		... 2 different plants		22. DIŒCIA	Monandria, Diand., Triand., Tetrand., Pentand., Hexand., Polyand., Monadelphia.
		Hermaphrodite, male, and female flowers on the same or on different plants		23. POLYGAMIA	Monœcia, Diœcia, Triœcia.
SEXUAL ORGANS ABSENT OR NOT APPARENT				24. CRYPTOGAMIA	Fungi, Lichenes, Algæ, Characeæ, Hepaticæ, Musci, Marsileaceæ, Lycopodiaceæ, Filices, Equisetaceæ.

In the first 13 classes the orders or subdivisions depend on the number of the styles or distinct sessile stigmas. They are as follows:

Monogynia, ...	1 style.
Digynia, ...	2 styles.
Trigynia, ...	3 ......
Tetragynia, ...	4 ......
Pentagynia, ...	5 ......
Hexagynia, ...	6 ......
Heptagynia, ...	7 ......
Octagynia, ...	8 ......
Enneagynia, ...	9 ......
Decagynia, ...	10 ......
Dodecagynia, ...	12 ......
Polygynia, ...	many ......

The whole of these orders do not occur in each class; sometimes only 2 or 3.

In the 14th class, Didynamia, there are 2 orders:

1. *Gymnospermia*, in which the seeds are naked (with thin ovaries); they are generally 4 in number,	Lavandula spica, *Lavender.*
2. *Angiospermia*, in which the seeds are enclosed in a distinct seed-vessel or pericarp,....................	Scrophularia nodosa, *Knotted Figwort.*

In the 15th class, Tetradynamia, there are 2 orders:

1. *Siliculosa*, with the seed-vessel a *silicula*, pouch, or short pod: see Fig. 34, page 106,....................	Crambe maritima, *Sea Kale.*
2. *Siliquosa*, with the seed-vessel a *siliqua* or long pod: see Fig. 33, page 106, ...	Sisymbrium nasturtium, *Water Cress.*

In the 16th, 17th, and 18th classes, Monadelphia, Diadelphia, and Polyadelphia, the orders are determined by the number of the stamens, the same characters as the first 13 classes.

In the 19th class, Syngenesia, there are 5 orders *:

1. *Polygamia Æqualis.* Here all the florets are hermaphrodite or perfect, each having stamens, and an ovary bearing seed,..................	Leontodon taraxacum, *Dandelion.*
2. *Polygamia Superflua.* Here the florets of the disk (342) are provided with stamens and pistil, while those of the ray (342) have only a pistil, both bearing seed,...	Tanacetum vulgare, *Tansy.*
3. *Polygamia Frustanea.* Here the florets of the disk have both stamens and pistil, while those of the ray have neither stamens nor pistil, or an abortive pistil (neuter),	Centaurea benedicta, *Blessed Thistle.*
4. *Polygamia Necessaria.* Here the florets of the disk have only stamens, those of the ray only pistils,	Calendula officinalis, *Common Marigold.*
5. *Polygamia Segregata.* In this order the common calyx or involucre encloses several smaller calices or cups, which separate and surround the florets,....................	Echinops, *Globe Thistle.*

In the 20th, 21st, and 22d classes, Gynandria, Monœcia, and Diœcia, the orders are founded on the characters of several of the preceding classes, generally on the number of the stamens.

* Linnæus had a 6th order, Monogamia, including plants with united anthers, but simple flowers, now generally placed in Pentandria, having little affinity with the Syngenesia.

CATALOGUE

OF

MEDICINAL PLANTS,

ARRANGED IN THEIR

NATURAL ORDERS;

SHEWING ALSO THE LINNÆAN CLASS AND ORDER OF EACH.

DIVISION I. CRYPTOGAMIA.

FUNGI, 174.*

Boletus igniarius, *Agaric of the Oak.*

LICHENES, 179.

Cetraria islandica, *Iceland Moss*, or *Liverwort.*
Rocella tinctoria, *Dyer's Lichen* or *Orchall.*

ALGÆ, 182.

Fucus vesiculosus, *Bladder Wrack.*

FILICES, 194.

Aspidium filix-mas, *Male Shield-Fern.*

* The numbers after the orders refer to the pages in which they are described.

DIVISION II. PHÆNOGAMIA.

SECT. I. MONOCOTYLEDONEÆ.

I. MONOHYPOGYNEÆ,

Stamens hypogynous.

Aroideæ, 200.

Arum maculatum, *Wake Robin*,............Monœcia Polyand.
Acorus calamus, *Sweet Flag*,...............Hexand. Monogyn.

Piperaceæ, 202.

Piper nigrum, *Black Pepper*,............ Piper longum, *Long Pepper*,............ Piper cubeba, *Cubebs*,......................	Triandria (Diandria) Trigynia

Gramineæ, 204.

Avena sativa, *Oat*,............................ Triticum hybernum. *Wheat*............. Hordeum distichum, *Barley*,............ Saccharum officinarum, *Sugar Cane*,....	Triandria Digyni

II. MONOPERIGYNEÆ,

Stamens perigynous.

Palmæ, 211.

Cocos butyracea, *Mackaw-tree*,.............Monœcia Hexand.

Colchicaceæ, 215.

Colchicum autumnale, *Meadow Saffron*,...Hexand. Trigynia.

Veratrum album, *White Hellebore*,...... Veratrum sabadilla, *Sabadilla*,...........	Polygamia Monœc.

ASPARAGINEÆ, 217.

Smilax sarsaparilla, *Sarsaparilla*,............DIŒCIA HEXANDRIA.

LILIACEÆ, 219.

Allium porrum, *Leek*,......................	HEXAND. MONOGYN.
——— sativum, *Garlic*,....................	
——— cepa, *Onion*,........................	
Aloe spicata, *Socotrine Aloe*,...............	
—— perfoliata, *Hepatic Aloe*,...........	
Scilla maritima, *Squill*,.....................	

III. MONOEPIGYNEÆ,

Stamens epigynous.

IRIDEÆ, 225.

Crocus sativus, *Saffron Crocus*............	TRIAND. MONOGYN.
Iris florentina, *Florentine Orris*,.........	

SCITAMINEÆ, 228.

Amomum zingiber, *Ginger*,...............	MONAND. MONOGYN.
——— cardamomum, } *Cardamom*,	
——— repens,......... }	
——— zedoaria, *Zedoary*, ...	
Curcuma longa, *Turmeric*..................	

SECT. II. DICOTYLEDONEÆ.

I. APETALEÆ.

ARISTOLOCHIÆ, 235.

Aristolochia serpentaria, *Snakeroot* or *Birthwort*,............................	GYNAND. HEXAND.
Asarum europæum, *Asarabacca*,.........	DODECAND. MONOGYN.

CUPULIFERÆ, 237.

Quercus robur, *Oak*,........................	MONŒCIA POLYAND.
Quercus infectoria, *Gall-nut Tree* or *Dyer's Oak*,........................	

CONIFERÆ, 239.

Pinus sylvestris, *Scotch Fir*,............	MONŒCIA MONADELPHIA.
—— larix, *Larch*,........	
—— balsamea, *Balsam Spruce*,..........	
—— abies, *Spruce Fir*,....................	
Juniperus sabina, *Savine*,..................	DIŒCIA MONADELPH.
———— communis, *Common Juniper*,	
———— lycia, *Olibanum*,.......	

SALICINEÆ, 242.

Salix alba, *White Willow*,...............	DIŒCIA DIANDRIA
—— fragilis, *Crack Willow*,............	
—— caprea, *Great-round-leaved Willow*.	

EUPHORBIACEÆ, 244.

Euphorbia officinarum, *Euphorbium*,......	DODECAND. TRIGYN.
Croton cascarilla, *Cascarilla*,.	MONŒC. MONADEL.
——— tiglium, *Purging Croton*,.........	
Ricinus communis, *Castor-oil Plant*,...	

URTICEÆ, 247.

Humulus lupulus, *Hop*,......................	DIŒCIA PENTAND.
Ulmus campestris, *Elm*,......................	PENTAND. DIGYNIA.
Morus nigra, *Mulberry*,.	MONŒCIA TETRAND.
Ficus carica, *Fig*,.......................... ...	POLYGAMIA TRIŒCIA.
Dorstenia contrajerva, *Contrajerva*,.........	TETRAND. MONOGYN.

MYRISTICEÆ, 250.

Myristica moschata, *Nutmeg Tree*,......	DIŒCIA (MONŒCIA) MONADELPHIA.

LAURINEÆ, 251.

Laurus cinnamomum, *Cinnamon Tree,*. ——— cassia, *Cassia Tree,*............... ——— camphora, *Camphor Laurel,*.... ——— nobilis, *Bay Laurel* or *Sweet Bay,*.............................. ——— sassafras, *Sassafras Laurel,*......	ENNEANDRIA MONOGYNIA.

POLYGONEÆ, 254.

Rheum palmatum, *Palmatum Rhubarb,* ——— undulatum, *Wave-leaved Rhubarb,*..............................	ENNEAND. TRIGYNIA.
Polygonum bistorta, *Great Bistort* or *Snake-weed,*....................	OCTAND. TRIGYNIA.
Rumex aquaticus, *Water Dock,*......... ——— acetosa, *Sorrel,*....................	HEXAND. TRIGYNIA.

THYMELEÆ, 256.

Daphne mezereum, *Spurge Laurel,*.........OCTAND. MONOGYN.

II. MONOPETALEÆ.

1. *HYPOCOROLLEÆ,*

Stamens hypogynous.

SCROPHULARINEÆ, 261.

Veronica beccabunga, *Brooklime,*......... Gratiola officinalis, *Hedge Hyssop,*.......	DIAND. MONOGYNIA.
Scrophularia nodosa, *Notty-rooted Figwort,*.............................. Digitalis purpurea, *Purple Foxglove,*...	DIDYNAMIA ANGIOSPERMIA.

Solaneæ, 263.

Atropa belladonna, *Deadly Nightshade* or *Dwale*,	Pentand. Monogyn.
Solanum dulcamara, *Woody Nightshade* or *Bittersweet*,	
Hyoscyamus niger, *Henbane*,	
Datura stramonium, *Thorn Apple*,	
Nicotiana tabacum, *Tobacco Plant*,	
Verbascum thapsus, *Great Mullein*,	
Capsicum annuum, *Cayenne* or *Cock-spur Pepper*,	

Jasmineæ, 267.

Olea europæa, *Olive Tree*,	Diand. Monogyn.
Fraxinus ornus, *Flowering Ash*,	Polygamia Diœcia.

Labiatæ, 269.

Mentha viridis, *Spearmint*,	Didynamia Gymnospermia.
—— piperita, *Peppermint*,	
—— pulegium, *Penny-royal*,	
Origanum vulgare, *Common Marjoram*,	
—— majorana, *Sweet Marjoram*,	
Hyssopus officinalis *Common Hyssop*,	
Lavandula spica, *Lavender*,	
Marrubium vulgare, *White Horehound*,	
Melissa officinalis, *Common Balm*,	
Rosmarinus officinalis, *Rosemary*,	Diand. Monogynia.
Salvia officinalis, *Garden Sage*,	

Boragineæ, 271.

Anchusa tinctoria, *Alkanet*,	Pentand. Monogyn.

Convolvulaceæ, 273.

Convolvulus jalapa, *Jalap*,	Pentand. Monogyn.
—— scammonia, *Scammony*,	

Gentianæ, 274.

Gentiana lutea, *Yellow Gentian*,	Pentand. Digynia.

Chironia centaurium, *Common Centaury,* Menyanthes trifoliata, *Buck Bean,*...... Spigelia marilandica, *Perennial Worm-grass,*...............................	PENTAND. MONOGYN.

APOCYNEÆ, 276.

Strychnos nux-vomica, *Ratsbane,*.........PENTAND. MONOGYN.

2. *PERICOROLLEÆ,*

Stamens perigynous.

STYRACEÆ, 280.

Styrax officinale, *Officinal Storax,*...... ——— benzoin, *Benjamin Tree*	DECAND. MONOGYN.

ERICINEÆ, 281.

Arbutus uva-ursi, *Bearberry,*............ Pyrola umbellata, *Winter Green,*......... Rhododendron chrysanthum, *Golden-flowered Rhododendron,*...........	DECAND. MONOGYN.

3. *EPICOROLLEÆ,*

Stamens epigynous.

COMPOSITÆ, 283.

1. *Corymbiferæ.*

Anthemis nobilis, *Chamomile,*............ ——— pyrethrum, *Pellitory of Spain,* Inula helenium, *Eleeampane,* .... Arnica montana, *Leopard's-bane,*. .... Artemisia absinthium, *Wormwood,*...... ——— santonica, *Southernwood,*...... ——— chinensis,........................ Tussilago farfara, *Coltsfoot,*................ Tanacetum vulgare, *Tansy,*................	SYNGENESIA POLYGAMIA SUPERFLUA.

2. *Cynarocephalæ.*

Arctium lappa, *Burdock,*	Syngenesia Polygamia Æqualis.
Centaurea benedicta, *Blessed Thistle,*...	Syngenesia Polygamia Frustranea.

3. *Cichoraceæ.*

Lactuca sativa, *Garden Lettuce,* .... ——— virosa, *Strong-scented Lettuce,*... Leontodon taraxacum, *Dandelion,*......	Syngenesia Polygamia Æqualis.

Valerianæ, 288.

Valeriana officinalis, *Great Wild Valerian,*..................................	Triandria Monogynia.

Rubiaceæ, 289.

Rubia tinctorum, *Madder,* ....Tetrand. Monogyn.

Cinchonaceæ, 290.

Cephaelis ipecacuanha, *Ipecacuan,* ...... Cinchona cordifolia, *Heart-leaved Cinchona,*.............................. ——— lancifolia, *Lance-leaved Cinchona,*.............................. ——— oblongifolia, *Oblong-leaved Cinchona,*..........................	Pentandria Monogynia.

Caprifoliaceæ, 293.

Sambucus nigra, *Common Elder,*........... Pentand. Trigynia.

III. POLYPETALEÆ.

1. *EPIPETALEÆ*,

Stamens epigynous.

UMBELLIFERÆ, 294.

Anethum graveolens, *Common Dill*,.....	PENTAND. DIGYNIA.
———— fœniculum, *Sweet Fennel*,....	
Carum carui, *Common Caraway*, ...	
Coriandrum sativum, *Common Coriander*	
Cuminum cyminum, *Cumin*,.............	
Pimpinella anisum, *Anise*,................	
Angelica archangelica, *Garden Archangelica*,...............................	
Conium maculatum, *Common Hemlock*,	
Bubon galbanum, *Lovage-leaved Bubon*,	
Ferula assafœtida, *Assafœtida*,...........	
Heracleum gummiferum, *Gum-bearing Heracleum*,........................ ..	
Pastinaca opoponax, *Rough Parsnip*,....	
Daucus carota, *Common Carrot*, ...	

2. *HYPOPETALEÆ*,

Stamens hypogynous.

RANUNCULACEÆ, 299.

Delphinium staphisagria, *Stavesacre*,....	POLYAND. TRIGYNIA.
Aconitum napellus, *Wolfs-bane*, or *Monkshood*,...........................	
Ranunculus acris, *Upright Meadow Crowfoot*,......................	POLYANDRIA POLYGYNIA.
———— flammula, *Lesser Spearwort*,	
Helleborus niger, *Black Hellebore*,......	
———— fœtidus, *Stinking Hellebore*,	

MAGNOLIACEÆ, 301.

Wintera aromatica, *Winter's-bark-tree*, ...POLYAND. TETRAGYN.

MENISPERMEÆ, 302.

Cocculus palmatus, *Calumba*,............ } DIŒCIA DODECAND.
Menispermum cocculus, *Moonseed*,...... }

RUTACEÆ, 304.

Diosma crenata, *Buchu*, ... } PENTANDRIA MONOGYNIA.
Bonplandia trifoliata, *Three-leaved Bonplandia*, ... }

Quassia simaruba, *Simaruba Quassia*,... }
——— excelsa, *Lofty Quassia*,.......... } DECAND. MONOGYN.
Guaiacum officinale, *Guaiacum*,.......... }
Ruta graveolens, *Common Rue*,.......... }

GERANIACEÆ, 305.

Oxalis acetosella, *Wood Sorrel*,..............DECAND. PENTAGYN.

MALVACEÆ, 307.

Althæa officinalis, *Marsh Mallow*,....... } MONADELPHIA POLYANDRIA.
Malva sylvestris, *Common Mallow*,...... }

GUTTIFERÆ, 309.

Stalagmitis cambogiodes, *Gamboge-tree*, ...POLYGAM. MONŒCIA.
Dryobalanops camphora, *Camphor-tree*,....POLYAND. MONOGYN.

AURANTIACEÆ, 310.

Citrus aurantium, *Orange-tree*, ... } POLYADELPH. ICOSANDRIA or POLYAND.
——— medica, *Lemon-tree*,............... }

VINIFERÆ, 312.

Vitis vinifera, the *Vine*,......................PENTAND. MONOGYN.

MELIACEÆ, 314.

Canella alba, *White Canella*,................ DODECAND. MONOG.
Swietenia febrifuga, *Febrifuge Swietenia*, } DECANDRIA MONOGYNIA.
——— mahagoni, *Mahogany-tree*,..... }

POLYGALEÆ, 315.

Polygala senega, *Seneka*, ...DIADELPH. OCTAND.
Krameria triandra, *Ratanhy*, ...TETRAND. MONOGYN.

PAPAVERACEÆ, 317.

Papaver somniferum, *White* or *Opium Poppy*,........................... ——— rhœas, *Red Poppy*,.............	POLYAND. MONOGYN.

CRUCIFERÆ, 319.

Cardamine pratensis, *Cuckoo-Flower*,... Sisymbrium nasturtium, *Water Cress*,. Sinapis alba, *White Mustard*,............ ——— nigra, *Common Mustard*,.........	TETRADYNAMIA SILIQUOSA.
Cochlearia armoracia, *Horse Radish*, ... ——— officinalis, *Scurvy-grass*,......	TETRADYNAMIA SILICULOSA.

VIOLARIÆ, 323.

Viola odorata, *Sweet Violet*, ...PENTAND. MONOGYN.

CARYOPHYLLEÆ, 324.

Dianthus caryophyllus, *Clove Pink*,........DECANDRIA DIGYN.

LINEÆ, 325.

Linum usitatissimum, *Common Flax*,... ——— catharticum, *Purging Flax*,......	PENTANDRIA PENTAGYNIA.

3. *PERIPETALEÆ*,

Stamens perigynous.

CUCURBITACEÆ, 329.

Cucumis colocynthis, *Bitter Cucumber*, Momordica elaterium, *Squirting Cucumber*,................................	MONŒCIA MONADELPHIA.

MYRTACEÆ, 331.

Myrtus pimenta, *Allspice-tree*,	ICOSANDRIA MONOGYNIA.
Punica granatum, *Pomegranate*,	
Eucalyptus resinifera, *Kino-tree*,	
Eugenia caryophyllata, *Clove-tree*,	
Melaleuca leucadendron,	POLYADELPHIA ICOSANDRIA.
——— cajeputi,	

SALICARIÆ, 333.

Lythrum Salicaria, *Loosestrife*,............DODECAND. MONOG.

ROSACEÆ, 334.

Fragariaceæ.	
Geum urbanum, *Avens* or *Herb-Bennet*,	ICOSAND. POLYGYN.
Tormentilla erecta, *Tormentil* or *Septfoil*,	
Agrimoniæ.	
Agrimonia eupatoria, *Agrimony*,	DODECAND. DIGYN.
Drupaceæ.	
Amygdalus communis, *Sweet Almond*,	ICOSAND. MONOGYN.
——— amara, *Bitter Almond*,	
——— persica, *Peach-tree*,	
Prunus domestica, *Common Plum*,	
——— Lauro-cerasus, *Cherry Laurel*,	
Roseæ.	
Rosa gallica, *Red Rose*,	ICOSAND. POLYGYN.
——— centifolia, *Hundred-leaved Rose*,	
——— canina, *Dog-Rose* or *Hep-tree*,	
Pomaceæ.	
Pyrus cydonia, *Quince-tree*,	ICOSAND. PENTAGYN.

LEGUMINOSÆ. 338.

1. *Papilionaceæ.*	DIADELPHIA DECANDRIA.
Astragalus tragacanthus,	
——— creticus,	
——— verus,	
Glycyrrhiza glabra, *Common Liquorice*,	
Pterocarpus draco, *Dragon's-Blood*,	
——— santalinus, *Red Saunders-tree*,	
——— erinacea, *Kino-tree*,	
Geoffroya inermis, *Cabbage-tree*,	
Dolichos pruriens, *Cowhage*,	
Spartium scoparium, *Broom*,	

Copaifera officinalis, *Copaiva-tree*,........ Myroxylon peruiferum, *Sweet-smelling Balsam-tree*,................ ——— toluiferum ?	DECANDRIA MONOGYNIA.
2. *Cassiæ.*	
Cassia fistula, *Purging Cassia*,........... ——— senna, *Senna*,...................... Hæmatoxylon campechianum, *Logwood*,	DECAND. MONOGYN.
Tamarindus indica, *Tamarind-tree*,......	MONADELPHIA TRIANDRIA.
3. *Mimosæ.*	
Acacia vera, *Acacia* or *Egyptian Thorn*, ——— arabica, *Gum-Arabic-tree*,......... ——— catechu, *Catechu*,..................	POLYGAM. MONŒCIA, or MONADELPHIA POLYANDRIA.

TEREBINTHACEÆ, 343.

Amyris elemifera, *Elemi-tree*,............ ——— gileadensis, *Balsam of Gilead-tree*,..................................	OCTAND. MONOGYN.
Boswellia serrata, *Olibanum-tree*,...........	DECAND. MONOGYN.
Pistacia terebinthus, *Chian Turpentine-tree*,............................... ——— lentiscus, *Mastich-tree*,...........	DIŒCIA PENTANDRIA.
Rhus toxicodendron, *Sumach* or *Poison Oak*,................................	PENTANDRIA TRIGYNIA.

RHAMNEÆ, 345.

Rhamnus catharticus, *Purging Buckthorn*,................................	PENTANDRIA MONOGYNIA.

CATALOGUE

OF

MEDICINAL PLANTS,

ARRANGED IN THEIR

LINNÆAN ORDERS;

SHEWING ALSO THEIR NATURAL ORDERS.

I. MONANDRIA.

Monandria Monogynia.

Amomum zingiber,	SCITAMINEÆ.
——— cardamomum	
——— repens,	
——— zedoaria,	
Curcuma longa,	

II. DIANDRIA.

Diandria Monogynia.

Veronica beccabunga,	SCROPHULARINEÆ.
Gratiola officinalis,	
Olea europæa,	JASMINEÆ.
Rosmarinus officinalis,	LABIATÆ.
Salvia officinalis,	

Diandria Trigynia.

See *Piper* in Triandria Trigynia.

III. TRIANDRIA.

Triandria Monogynia.

Crocus sativus, ...	IRIDEÆ.
Iris florentina,.....................	IRIDEÆ.
Valeriana officinalis,..................	VALERIANÆ.

Triandria Digynia.

Avena sativa, ...	GRAMINEÆ.
Triticum hybernum,................	GRAMINEÆ.
Hordeum distichum,...............	GRAMINEÆ.
Saccharum officinarum,.	GRAMINEÆ.

Triandria Trigynia.

Piper nigrum, ...	PIPERACEÆ.
—— longum, ...	PIPERACEÆ.
—— cubeba, ...	PIPERACEÆ.

IV. TETRANDRIA.

Tetrandria Monogynia.

Dorstenia contrajerva, ...	URTICEÆ.
Rubia tinctorum,......................	RUBIACEÆ.
Krameria triandra, ...	POLYGALEÆ.

V. PENTANDRIA.

Pentandria Monogynia.

Atropa belladonna, ...	SOLANEÆ.
Solanum dulcamara,................	SOLANEÆ.
Hyoscyamus niger,.................	SOLANEÆ.
Datura stramonium,...............	SOLANEÆ.
Nicotiana tabacum, ...	SOLANEÆ.
Verbascum thapsus,...............	SOLANEÆ.
Capsicum annuum,.................	SOLANEÆ.
Anchusa tinctoria, ...	BORAGINEÆ.
Convolvulus jalapa,................	CONVOLVULACEÆ.
———— scammonia, ...	CONVOLVULACEÆ.

Chironia centaurium,............... Menyanthes trifoliata,............. Spigelia marilandica,...............	GENTIANÆ.
Strychnos nux-vomica,...............	APOCYNEÆ.
Cephaelis ipecacuanha,............ Cinchona cordifolia,................. ——— lancifolia,................. ——— oblongifolia,.............	CINCHONACEÆ.
Diosma crenata,...................... Bonplandia trifoliata,..............	RUTACEÆ.
Vitis vinifera,.........................	VINIFERÆ.
Viola odorata,.........................	VIOLAREÆ.
Rhamnus catharticus,.................	RHAMNEÆ.

Pentandria Digynia.

Ulmus campestris,....................	URTICEÆ.
Gentiana lutea,........................	GENTIANÆ.
Anethum graveolens,.............. ——— fœniculum,............... Carum carui,......................... Coriandrum sativum,............... Cuminum cyminum,............... Pimpinella anisum,................. Angelica archangelica,............ Conium maculatum,................ Bubon galbanum,................... Ferula assafœtida,................. Heracleum gummiferum,......... Pastinaca opoponax,............... Daucus carota,.......................	UMBELLIFERÆ.

Pentandria Trigynia.

Sambucus nigra,......................	CAPRIFOLIACEÆ.
Rhus toxicodendron..................	TEREBINTHACEÆ.

Pentandria Pentagynia.

Linum usitatissimum............... ——— catharticum.................	LINEÆ.

Dodecandria Digynia.

Agrimonia eupatoria .... Rosaceæ.

Dodecandria Trigynia.

Euphorbia offic narum .... Euphorbiaceæ.

XII. ICOSANDRIA.

Icosandria Monogynia.

Myrtus pimenta......................	
Punica granatum.....................	Myrtaceæ.
Eucalyptus resinifera	
Eugenia caryophyllata...............	
Amygdalus communis..............	
———— amara....................	
———— persica	Rosaceæ.
Prunus domestica....................	
——— Lauro-cerasus.............	

Icosandria Pentagynia.

Pyrus cydonia............... ....Rosaceæ.

Icosandria Polygynia.

Geum urbanum..	
Tormentilla erecta	
Rosa gallica..........................	Rosaceæ.
—— centifolia..........................	
—— canina...............................	

XIII. POLYANDRIA.

Polyandria Monogynia.

Dryobalanops camphora ....Guttiferæ.

Papaver somniferum.	Papaveraceæ.
——— rhœas	

Polyandria Trigynia.

Aconitum napellus....................	Ranunculaceæ.
Delphinium staphisagria.	

Polyandria Polygynia.

Ranunculus acris	RANUNCULACEÆ.
——— flammula	
Helleborus niger	
——— fœtidus	

XIV. DIDYNAMIA.

Didynamia Gymnospermia.

Mentha viridis	LABIATÆ.
——— piperita	
——— pulegium	
Origanum vulgare	
——— majorana	
Hyssopus officinalis	
Lavandula spica	
Marrubium vulgare	
Melissa officinalis	

Didynamia Angiospermia.

Scrophularia nodosa	SCROPHULARINEÆ.
Digitalis purpurea	

XV. TETRADYNAMIA.

Tetradynamia Siliquosa.

Cardamine pratensis	CRUCIFERÆ.
Sisymbrium nasturtium	
Sinapis alba	
——— nigra	

Tetradynamia Siliculosa.

Cochlearia armoracia	CRUCIFERÆ.
——— officinalis	

XVI. MONADELPHIA.

Monadelphia Triandria.

Tamarindus indica..................LEGUMINOSÆ.

VI. HEXANDRIA.

Hexandria Monogynia.

Acorus calamus .... AROIDEÆ.

Allium sativum .... LILIACEÆ.
——— cepa ....
——— porrum ....
Aloe spicata ....
—— perfoliata.......................
Scilla maritima ....

Hexandria Trigynia.

Colchicum autumnale................ COLCHICACEÆ.

Rumex aquaticus .... POLYGONEÆ.
——— acetosa ....

VII. HEPTANDRIA,

Heptandria Monogynia.

Æsculus hippocastanum .... HIPPOCASTANEÆ.

VIII. OCTANDRIA.

Octandria Monogynia.

Daphne mezereum .... THYMELEÆ.

Amyris elemifera .... TEREBINTHACEÆ.
——— gileadensis ....

Octandria Trigynia.

Polygonum bistorta .... POLYGONEÆ.

IX. ENNEANDRIA.

Enneandria Monogynia.

Laurus cinnamomum .... LAURINEÆ.
——— cassia ....
——— camphora ....
——— nobilis ....
——— sassafras ....

Enneandria Trigynia.

Rheum palmatum	Polygoneæ.
——— undulatum	Polygoneæ.

X. DECANDRIA.

Decandria Monogynia.

Styrax officinale	Styraceæ.
——— benzoin	Styraceæ.
Arbutus uva-ursi	Ericineæ.
Pyrola umbellata	Ericineæ.
Rhododendron chrysanthum	Ericineæ.
Guaiacum officinale	Rutaceæ.
Ruta graveolens	Rutaceæ.
Quassia simaruba	Rutaceæ.
——— excelsa	Rutaceæ.
Swietenia febrifuga	Meliaceæ.
——— mahagoni	Meliaceæ.
Copaifera officinalis	Leguminosæ.
Myroxylon peruiferum	Leguminosæ.
——— toluiferum	Leguminosæ.
Hæmatoxylon campechianum	Leguminosæ.
Cassia fistula	Leguminosæ.
——— senna	Leguminosæ.

Decandria Digynia.

Dianthus caryophyllus ....Caryophylleæ.

Decandria Pentagynia.

Oxalis acetosella ....Geraniaceæ.

XI. DODECANDRIA.

Dodecandria Monogynia.

Asarum europæum......................Aristolochiæ.

Canella alba..............................Meliaceæ.

Lythrum salicaria ....Salicariæ.

Croton cascarilla	EUPHORBIACEÆ.
——— tiglium	
Ricinus communis	
Cucumis colocynthis	CUCURBITACEÆ.
Momordica elaterium	

XXII. DIŒCIA.

Diœcia Diandria.

Salix alba	SALICINEÆ.
—— fragilis	
—— caprea	

Diœcia Pentandria.

Humulus lupulus	URTICEÆ.
Pistacia terebinthus	TEREBINTHACEÆ.
——— lentiscus	

Diœcia Hexandria.

Smilax sarsaparilla	ASPARAGINEÆ.

Diœcia Dodecandria.

Cocculus palmatus	MENISPERMEÆ.
Menispermum cocculus	

Diœcia Monadelphia.

Juniperus sabina	CONIFERÆ.
——— communis	
——— lycia	
Myristica moschata	MYRISTICEÆ.

XXIII. POLYGAMIA.

Polygamia Monœcia.

Veratrum album	COLCHICACEÆ.
——— sabadilla	
Stalagmites cambogioides	GUTTIFERÆ.

Acacia vera	LEGUMINOSÆ.
—— arabica	
—— catechu	

Polygamia Diœcia.

Fraxinus ornus ....JASMINEÆ.

Polygamia Triœcia.

Ficus carica ....URTICEÆ.

XXIV. CRYPTOGAMIA.

See page 353.

Monadelphia Polyandria.

Althæa officinalis	MALVACEÆ.
Malva sylvestris	MALVACEÆ.

XVII. DIADELPHIA.

Diadelphia Octandria.

Polygala senega........................POLYGALEÆ.

Diadelphia Decandria.

Astragalus tragacanthus	LEGUMINOSÆ.
——— creticus	LEGUMINOSÆ.
——— verus	LEGUMINOSÆ.
Glycyrrhiza glabra	LEGUMINOSÆ.
Pterocarpus draco	LEGUMINOSÆ.
——— santalinus	LEGUMINOSÆ.
——— erinacea	LEGUMINOSÆ.
Geoffroya inermis	LEGUMINOSÆ.
Dolichos pruriens	LEGUMINOSÆ.
Spartium scoparium	LEGUMINOSÆ.

XVIII. POLYADELPHIA.

Polyadelphia Icosandria.

Melaleuca leucadendron	MYRTACEÆ.
——— cajeputi	MYRTACEÆ.

Polyadelphia Polyandria.

Citrus aurantium	AURANTIACEÆ.
——— medica	AURANTIACEÆ.

XIX. SYNGENESIA.

Polygamia Æqualis.

Arctium lappa .... COMPOSITÆ CYNAROCEPHALÆ.

Lactuca sativa	COMPOSITÆ CICHORACEÆ.
——— virosa	COMPOSITÆ CICHORACEÆ.
Leontodon taraxacum	COMPOSITÆ CICHORACEÆ.

Polygamia Superflua.

Anthemis nobilis	Compositæ Corymbiferæ.
——— pyrethrum	
Inula helenium	
Arnica montana	
Artemisia absinthium	
——— santonica	
——— chinensis	
Tussilago farfara	
Tanacetum vulgare	

Polygamia Frustranea.

Centaurea benedicta .... Compositæ Cynarocephalæ.

XX. GYNANDRIA.

Gynandria Hexandria.

Aristolochia serpentaria ....Aristolochiæ.

XXI. MONŒCIA.

Monœcia Tetrandria.

Morus nigra..............................Urticeæ.

Monœcia Hexandria.

Cocos butyracea ....Palmæ.

Monœcia Polyandria.

Arum maculatum ....Aroideæ.

Quercus robur	Cupuliferæ.
——— infectoria	

Monœcia Monadelphia.

Pinus sylvestris	Coniferæ.
——— larix	
——— balsamea	
——— abies	

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